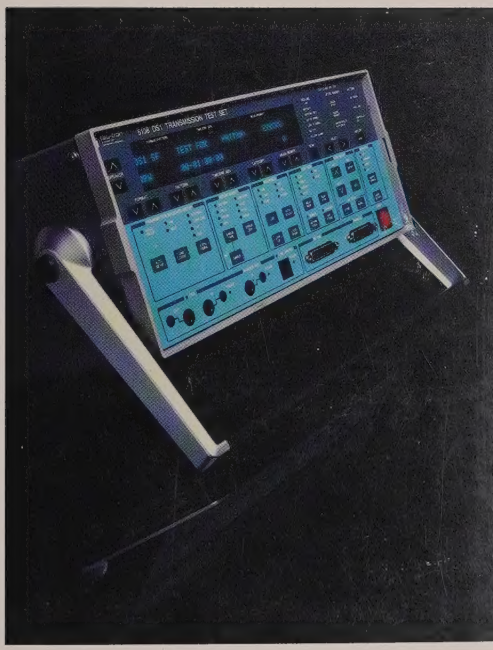
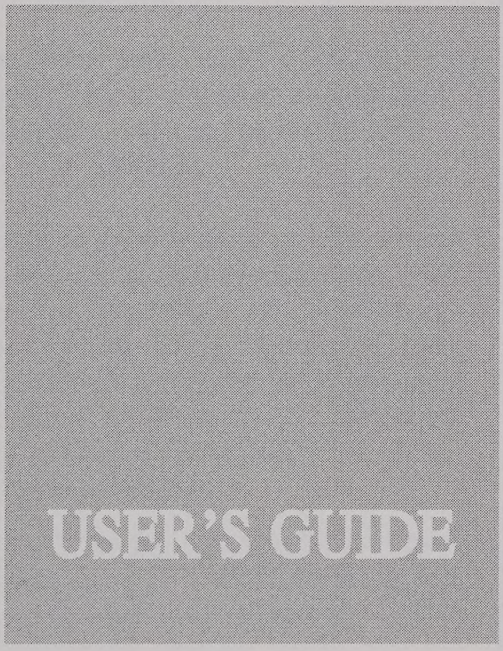


# MODEL 5108
# T1/DS1 Digital Transmission Test Set

tau-tron
A UNIT OF
GENERAL SIGNAL

PART NO. 8200-0205




# MODEL 5108
# T1/DS1 Digital Transmission Test Set

**Tau-tron Inc., A Unit of General Signal**
**10 Lyberty Way, Westford, MA 01886**
**(508) 692-5100 • 1-800-828-8766**
**Fax (508) 692-1938 • Telex 750245**

## – WARRANTY –

**ALL TAU-TRON TEST SETS ARE WARRANTED AGAINST ANY DEFECTS IN MATERIAL AND WORKMANSHIP, FOR A PERIOD OF *3 YEARS*.**

This Warranty applies from the date of delivery for all Tau-tron test sets. Other manufacturer's products offered by Tau-tron such as printers, cables, etc. are covered to the extent of their own warranty. Calibration of Tau-tron test sets is covered for one year from date of delivery. However, some restrictions apply; see your salesman for further details.

We will repair or replace test sets which, upon our examination, prove to be defective during the warranty period, except in cases of product abuse or attempted field repair.

No other Warranty, expressed or implied, including fitness for purpose, merchantability or otherwise, is given.

For assistance, contact Customer Service with details of the instrument model, serial numbers, and malfunction; see Repair Returns on the next page.

## SHIPPING DAMAGE

If any signs of damage are noticeable on the outside of the carton, request that the carrier's agent be present during unpacking. If external damage is found on the instrument, follow the Repair Returns procedure below.

Check the electrical performance of the instrument as soon as possible after receipt. If there are any malfunctions, follow the Repair Returns procedure below.

## REPAIR RETURNS

In case of mechanical damage or electrical malfunctions, notify Tau-tron immediately. If the damage occurred during shipping, also notify the carrier. To return a unit for repair:

1. Call the Customer Service Department, **(508) 692-5100** or **1-800-344-8131**, for a **Repair Authorization Number**. This number reduces administrative delays and ensures prompt return of your unit.

2. Complete and attach the **Repair Tag**, in the back of this manual, **to your unit** for positive identification.

3. Pack the unit in the original shipping carton and packing materials, if available. Otherwise use a double-walled carton (test strength of 350lb; 159kg) and shock-absorbing material such as bubblewrap, to prevent the unit from moving in the carton during transit. Secure the carton by sealing it with heavy paper tape.

4. Send to: Tau-tron Inc.
   10 Lyberty Way
   Westford, MA 01886
   *Attn:* Customer Service

# 5108
# DS1 TRANSMISSION TEST SET
## Table of Contents

**Contents** **Page**

**1. Introduction ..... 1**
1.1 Description of the 5108 ..... 1
1.2 How to Use This Manual ..... 2
1.3 Getting Started ..... 3
1.3.1 Initial Power-up and Checkout ..... 3

**2. Tutorial ..... 5**
2.1 Options ..... 5
2.2 Power ..... 7
2.2.1 AC Power ..... 7
2.2.2 DC Power ..... 8
2.2.3 Power Source Priority ..... 9
2.2.4 Power On ..... 9
2.3 The Main Display ..... 10
2.3.1 Format/Pattern Field ..... 10
2.3.2 Time/Err Gen Field ..... 10
2.3.3 Measurement Field ..... 10
2.4 Control Types ..... 11
2.4.1 Menu Keys ..... 11
2.4.2 Display Keys ..... 12
2.4.3 Action Keys ..... 12
2.5 Control Organization ..... 13
2.6 Input/Output Connectors ..... 14
2.7 Indicators (LEDs) ..... 14
2.8 Tones ..... 14

**3. Applications ..... 15**
3.1 Using a Printer ..... 15
3.1.1 Turning Reports On and Off ..... 15
3.1.2 Customizing Summary Reports ..... 15
3.1.3 Port Setup and Cables ..... 16
3.1.4 Using the Optional Seiko Printer ..... 17

**Contents** **Page**

3.2 Remote Control ..... 18
3.3 Example Procedures ..... 19
3.3.1 Continuous In-service Testing ..... 19
3.3.2 Timed In-service Performance Testing ..... 22
3.3.3 1-hour DS1 Path Test ..... 23
3.3.4 Automatic Testing ..... 25

**4. Front Panel Reference ..... 27**
4.1 Format and Pattern ..... 27
4.1.1 Format ..... 27
4.1.2 Pattern ..... 28
4.2 Transmitter/Receiver Setup ..... 30
4.2.1 Auto Setup ..... 30
4.2.2 Line Code Key ..... 32
4.2.3 Path/Timing ..... 33
4.3 Error Inject Group ..... 34
4.3.1 Error Type ..... 34
4.3.2 Single ..... 34
4.3.3 Error Gen (error generation) ..... 35
4.4 Time/Err Gen (timing & error generation) ..... 36
4.4.1 Test Interval ..... 36
4.4.2 Elapsed Time ..... 36
4.4.3 Time Remaining ..... 37
4.4.4 Time of Day ..... 37
4.4.5 Date ..... 37
4.4.6 Error Generation Ratio ..... 38
4.5 Interface Group ..... 39
4.5.1 Intfc Select (interface select) ..... 39
4.5.2 LBO (line build out) ..... 40
4.5.3 Loop Up ..... 41
4.5.4 Loop Down ..... 42

**Contents** **Page**

4.6 Test Run ..... 43
4.6.1 Meas Mode (measurement mode) ..... 43
4.6.2 Run/Stop ..... 44
4.6.3 Return Local ..... 45
4.6.4 Aux Fctns (auxiliary functions) ..... 45
4.7 Category, Measurement, and Scan ..... 46
4.7.1 Category ..... 46
4.7.2 Measurement ..... 48
4.7.3 Scan ..... 49
4.8 Data Entry and Select Group ..... 50
4.8.1 Select ..... 50
4.8.2 Incr and Decr (increment / decrement) ..... 50
4.8.3 Enter/Edit ..... 51
4.8.4 Exit ..... 51
4.8.5 Unit Setup–Store and Recall ..... 51
4.9 Reports ..... 53
4.9.1 Report Enable ..... 53
4.9.2 Quick Report ..... 53
4.10 Status and History Indicators ..... 54
4.10.1 Pulses Indicators ..... 56
4.10.2 History Reset ..... 56
4.11 Input/Output Connectors ..... 57
4.11.1 DSX Out ..... 58
4.11.2 DSX In ..... 58
4.11.3 Wander Ref (wander reference) ..... 58
4.11.4 Line/Probe ..... 58
4.11.5 RS-232 Port ..... 59
4.11.6 Parallel Port ..... 59

**Contents** **Page**

**5. Measurements and Reports ..... 61**
5.1 General Definitions ..... 61
5.1.1 Errored and Severely–Errored Seconds ..... 61
5.1.2 Consecutively Severely Errored Seconds ..... 61
5.1.3 Available and Unavailable Seconds ..... 63
5.1.4 Degraded Minutes ..... 63
5.1.5 Bit Error Ratios ..... 63
5.1.6 Synchronous Errored Seconds ..... 63
5.2 Pattern Measurements ..... 64
5.3 CRC-6 Measurements ..... 65
5.4 Frame Measurements ..... 66
5.5 BPV/0's Measurements ..... 67
5.6 G.821 Measurements ..... 68
5.7 Signal Measurements ..... 69
5.8 Slips Counts ..... 70
5.9 Alarm Counts ..... 71
5.10 Jitter Measurements (optional) ..... 72
5.11 Wander Measurements (optional) ..... 73
5.12 Reports ..... 74
5.12.1 Summary Reports ..... 74
5.12.2 Event Reports ..... 77
5.12.3 Messages ..... 80
**6. Auxiliary Functions ..... 83**
6.1 Test Scheduling (scheduling) ..... 83
6.2 Print Setup (pri_setup) ..... 84
6.3 Reporting Interval (report intvl) ..... 86
6.4 Report Formatting (report frmt) ..... 87
6.5 User-defined Pattern (user pat) ..... 88
6.6 Other Functions (other_setup) ..... 89
6.6.1 Thresholds ..... 89
6.6.2 RS-232 Port Setup ..... 92
6.6.3 Custom Loop Codes ..... 93

**Contents** **Page**

**7. Specifications ..... 95**
7.1 Internal Clock ..... 95
7.2 Compatibility ..... 95
7.3 Patterns ..... 95
7.4 DS1 Output ..... 95
7.5 DS1 Input ..... 96
7.6 T1C Output (optional) ..... 96
7.7 T1C Input (optional) ..... 96
7.8 Line/Probe Interface ..... 96
7.9 Jitter Measurement ..... 97
7.10 Wander Measurement ..... 97
7.11 General ..... 98

**8. Appendices ..... 99**
8.1 Checking and Changing the Fuse ..... 99
8.1.1 AC Fuse ..... 99
8.1.2 DC Fuse ..... 99
8.2 Remote Control Commands ..... 101
8.2.1 RS-232 Printer State ..... 101
8.2.2 RS-232 Interactive State ..... 101
8.2.3 Remote Command Entry ..... 103
8.3 Interface Pinouts and Cabling ..... 113
8.3.1 RS-232 Cables ..... 114
8.4 Bridging Probe ..... 116
8.4.1 Using the Bridging Probe ..... 117
8.4.2 Probe Applications ..... 117
8.4.3 Probe Specifications ..... 121
8.5 Volts Peak to dBdsx Conversion ..... 122

## List of Figures


| Figure | Title | Page |
|---|---|---|
| 2-1 | Serial Number Tag | 5 |
| 2-2 | Fuse Locations and Power Connectors | 7 |
| 2-3 | Side-panel DC Power Jack | 8 |
| 2-4 | Front Panel Display | 10 |
| 2-5 | Example Menu Key Control | 11 |
| 2-6 | Example Display Key Control | 12 |
| 3-1 | In-service Performance Test | 19 |
| 3-2 | DS1 Path Test | 23 |
| 3-3 | Automatic Testing | 25 |
| 4-1 | Format and Pattern | 27 |
| 4-2 | Transmitter/Receiver Setup Group | 30 |
| 4-3 | Error Inject Group | 34 |
| 4-4 | Time/Err Gen | 36 |
| 4-5 | Interface Group | 39 |
| 4-6 | Test Run Group | 43 |
| 4-7 | Category, Measurement, and Scan | 46 |
| 4-8 | Data Entry Group with Select | 50 |
| 4-9 | Reports Group | 53 |
| 4-10 | Status and History Indicators | 54 |
| 4-11 | Front Panel Connectors | 57 |
| 5-1 | Example CSES Measurement | 62 |
| 5-2 | Example Summary Report | 76 |
| 6-1 | Example Pri_Setup Report | 85 |
| 8-1 | Checking and Changing the Fuses | 100 |
| 8-2 | Smart Null-modem Cable Wiring | 115 |
| 8-3 | Dumb Straight-through Cable Wiring | 115 |
| 8-4 | 5108 Bridge Probe | 116 |
| 8-5 | Probe Used at HF Distribution Frame | 118 |
| 8-6 | Probe Used at CSU Location | 119 |
| 8-7 | General Bridge Probe Hook-up | 120 |

## List of Tables


| Table | Title | Page |
|---|---|---|
| 2-1 | Option Codes | 6 |
| 2-2 | Control Groups Organization | 13 |
| 3-1 | Seiko DPU-411 Printer Setup | 17 |
| 4-1 | Pattern Selections | 29 |
| 4-2 | Measurement Categories | 47 |
| 4-3 | Measurement Types | 48 |
| 4-4 | DSX/Line (In) Indicators Group | 55 |
| 4-5 | Jitter/Wander Indicators Group | 55 |
| 4-6 | Pattern Indicators Group | 55 |
| 5-1 | Pattern Measurements | 64 |
| 5-2 | CRC-6 Measurements | 65 |
| 5-3 | Frame Measurements | 66 |
| 5-4 | BPV/0's Measurements | 67 |
| 5-5 | G.821 Measurements | 68 |
| 5-6 | Signal Measurements | 69 |
| 5-7 | Alarm Counts | 71 |
| 5-8 | Jitter Measurements | 72 |
| 5-9 | Wander Measurements | 73 |
| 5-10 | Events Abbreviations | 78 |
| 6-1 | Auxiliary Other_Setup Thresholds Summary | 91 |
| 8-1 | Error Codes, Computer Mode | 102 |
| 8-2 | Remote Control Commands | 105-112 |
| 8-3 | Line Interface Pinout | 113 |
| 8-4 | RS-232 Interface Pinout | 113 |
| 8-5 | Parallel Interface Pinout | 114 |
| 8-6 | Volts Peak to dBdsx Conversion | 123-127 |

# 1. Introduction

## 1.1 DESCRIPTION OF THE 5108

The 5108 DS1 Digital Transmission Test Set is a versatile and comprehensive test instrument. It can perform a variety of simultaneous measurements on virtually any DS1 or (optionally) on T1C signal paths including over digital radio, fiberoptic, and satellite transmission systems.

The 5108 is designed to be easy to use. All of the controls and connectors are on the front panel, and operations are menu-driven. LED indicators tell you the status of over 40 parameters at a glance and the fluorescent display provides even more detailed results.

To get the most out of your 5108, read this manual carefully and become familiar with the test set's many uses. We would appreciate your comments about any errors or omissions you discover in this manual. Please use the feedback card in the back of this manual and address all correspondence to:

Tau-tron Inc.
ATTN: Publications Manager
10 Lyberty Way
Westford, MA 01886

## 1.2 HOW TO USE THIS MANUAL

This manual is divided into eight parts:

1. Introduction
2. Tutorial
3. Applications
4. Front Panel Reference
5. Measurements and Reports
6. Auxiliary Functions
7. Specifications
8. Appendices

The **Introduction** describes the 5108, explains how to use this manual, and shows how to initially power-up the unit and check to make sure it is working correctly.

**Tutorial** familiarizes you with the unit's controls, indicators, and method of operation.

**Applications** includes step-by-step examples of test applications to help you get up and running on the 5108 as quickly as possible.

The **Front Panel Reference** section contains detailed descriptions of all the 5108's front-panel keys, LEDs, signal jacks, and interface ports.

**Measurements and Reports** defines the 5108's many measurements and explains how to generate and interpret printed reports.

The **Auxiliary Functions** section covers all of the 5108 features that are accessed through the AUX FCTNS key and menus, such as user-defined patterns and error thresholds.

The **Appendices** contain other information you may need, such as remote-control commands and interface pinouts.

## 1.3 GETTING STARTED

As you unpack the 5108, check both the shipping box and the unit for any signs of damage. Be sure to save all paperwork in case you need to contact the shipper or Tau-tron. In the shipping box you should find:

- One 5108 Test Set with front cover
- One power cord
- This manual

Follow the procedures below for an initial 5108 power-up and check-out.

### 1.3.1 Initial Power-up and Checkout

1. Connect AC or DC power (see Sec 2.1).
2. Press the POWER switch on the lower right of the front panel.
   > Check that the display shows the software revision number for a moment. The display will also show which options have been installed (Jitter/Wander and/or T1C).
   > Make sure the STOP LED is lit. If it is not, press the RUN/STOP key.
3. Press RECALL on the front panel.
   > Check that "0" in "SETUP- 0" on the display is flashing.
4. Press ENTER
   The Factory Setup has been loaded.
   > Check that the main display shows the following:

```
DS1 SF     ELAPSED      FRAME:    ERRORS
QRW        00-00:00:00                 0
```

4. *(continued)*
   > Check that the front panel menu LEDs show the following:

| | |
|---|---|
| AUTO SETUP: | off |
| LINE CODE: | AMI |
| PATH/TIMING: | INTERNAL |
| ERROR TYPE: | PATTERN |
| ERROR GEN: | ERR FREE |
| LBO | off |
| INTFC SELECT: | DSX |
| MEAS MODE: | CONT |
| RUN/STOP: | STOP |
| REMOTE (LED): | off |
| AUXILIARY (LED): | off |
| REPORT ENABLE: | ALL |

   > Check that all STATUS and HISTORY indicators are OFF. If not, press the RESET key.

5. Connect DSX OUT to DSX IN with a 310 or Bantam patch cord.

6. Press RUN/STOP.
   > Check that ELAPSED time is incrementing once every second.

   > Check that no Status LEDs are lit or flashing.

7. Press RUN/STOP.
   > Check that ELAPSED time stops incrementing.

Now you can try the examples in Section 3.3. These tests are also a good way to further check out the 5108.

# 2. Tutorial

This section of the manual includes basic descriptions of the 5108's controls and indicators, and familiarizes you with the set's method of operation.

## 2.1 OPTIONS

The 5108 can be ordered with several different options. To verify which options are installed in your 5108 refer to the Serial Number Tag on the rear of the unit (see Fig 2-1).

The option code number shown on the Serial Number Tag (if any) will be either 01, 02, or 03. Table 2-1 describes the option codes (next page).

The 5108 also lists its installed options on its display each time it is powered up.

**Figure 2-1**
**Serial Number Tag**

**Table 2-1**
**Option Codes**

| Option # | Part # | Description |
|---|---|---|
| 01 | 9505-8300-01 | **DS1 Jitter/Wander Measurement.**<br>This option allows the 5108 to perform various jitter and wander (MTIE) measurements in addition to the standard measurement set. |
| 02 | 9505-8300-02 | **T1C Rate Measurement.**<br>This option allows the 5108 to perform many of its standard measurements at the higher DS1-C rate of 3.152 Mbps, as well as at the DS1 rate. |
| 03 | 9505-8300-03 | **Jitter/Wander *and* T1C Measurement.**<br>This option allows the 5108 to perform both Jitter/Wander and T1C-rate measurements, as described above, in addition to its standard measurements. |

If you have questions about your 5108, or would like retrofit or upgrade information, call (508) 692-5100 or (outside MA) 1-800-828-8766 (1-800-TAU-TRON).

## 2.2 POWER

The 5108 can be powered from AC or DC power.

### 2.2.1 AC Power

Connect the 5108 to AC power by simply plugging the female end of the supplied power cord into the connector on the back of the 5108 (see Fig 2-2). Next plug the other end of the cord into a properly grounded wall outlet.

AC fusing should be:

**1A Slo-Blo for 115V**

See Section 7.1 for instructions on checking and changing the AC and DC fuses.

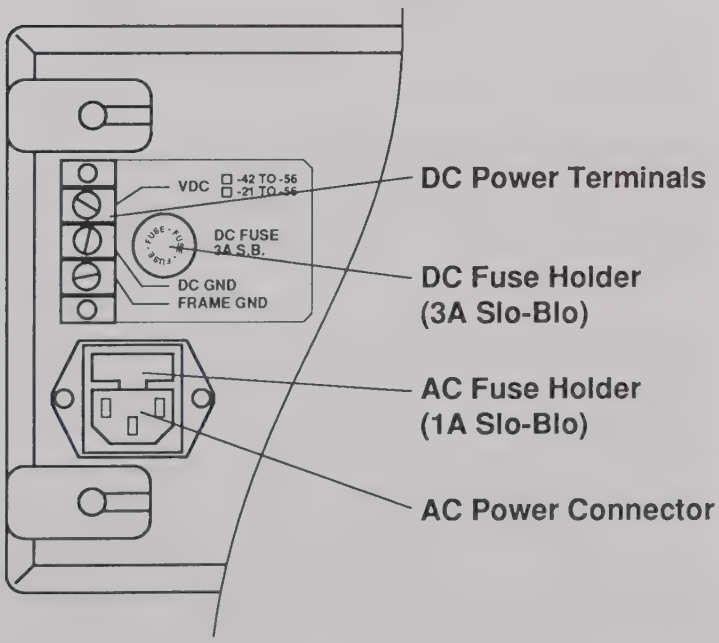



**Figure 2-2**
**Fuse Locations and Power Connectors**

### 2.2.2 DC Power

There are two ways to connect the 5108 to DC power:

1. Using the rear-panel terminal block, or
2. Using the right-side mounted 310-jack input.

In both cases, the acceptable DC range is **-21 to -56 Vdc**.

#### 2.2.2.1 Rear-panel DC Connection

Before connecting the DC source to the 5108, make sure both the 5108 and the power source are turned Off.

- Connect Earth Ground to the Chassis ground: the bottom terminal on the rear of the test set.
- Connect the negative lead from the DC source to VDC (the topmost terminal).
- Connect the DC Ground (DC Return) to the middle terminal.

Refer to Figure 2-2 (page 7).

#### 2.2.2.2 310-Jack DC Connection (side panel)

The 310-jack DC Input is located on the right side of the 5108. See Figure 2-3.

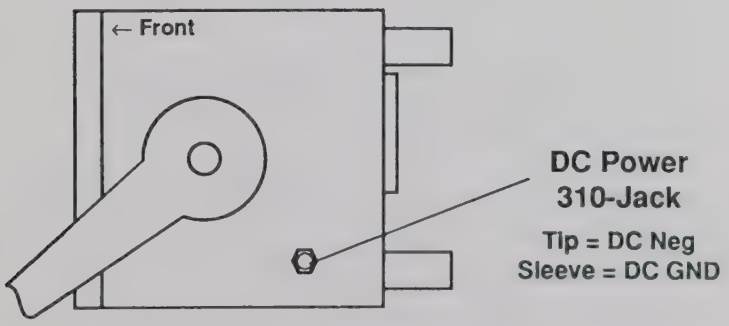



**Figure 2-3**
**Side-panel DC Power Jack**

When using a 310-jack to connect DC power, note that:

Tip = Negative DC
Sleeve = DC Ground

For added safety, ground the 5108 using the lowest terminal on the rear-panel terminal block (Chassis GND) when using the 310-jack DC Input. See Figure 2-2 (page 7).

**Note:** Insert the 310 plug into the 5108's DC-in jack **before** connecting the DC power source to avoid damaging the test set.

### 2.2.3 Power Source Priority

The 5108 may be powered by either AC or DC power. If both types are connected to the test set, the AC power will override the DC power. This does not damage the 5108.

The 310-jack DC Input disables the rear-panel DC terminal block. If both are connected, only the 310-jack will supply power to the 5108.

**Note:** The 310-jack DC Power Input is located on the **right side** panel of the test set. *Never* insert a 310 Power plug into any of the front-panel jacks.

### 2.2.4 Power On

When the power is properly connected, turn on the 5108 by pressing the red power switch in the lower right corner of the front panel. Press the switch again to turn the unit off. When the unit is on, the switch lights red. Each time the unit is turned on the display shows a startup readout (see Sec 1.3).

The 5108 always repowers in the same configuration as it was when powered down. If there is a power failure any tests in progress are restarted. To return to a known configuration, use RECALL to load Setup 0, the factory-programmed configuration (see Sec 4.8.5).

## 2.3 THE MAIN DISPLAY

All measurement setup parameters and results appear on the main display when they are selected or edited. The display is divided into three fields labeled: FORMAT/PATTERN, TIME/ERR GEN, and MEASUREMENT (See Fig 2-4).

### 2.3.1 Format/Pattern Field

This field shows line rate, framing format, and data pattern.

The top line displays "DS1" or "T1C" (if the T1C option is installed) and the currently selected frame format. The bottom line displays the currently selected data pattern.

### 2.3.2 Time/Err Gen Field

This field shows time related parameters and the generated error ratio.

The top line identifies a selected time parameter or "ERR GEN" (the transmitted error ratio). The bottom line displays the value of that parameter.

### 2.3.3 Measurement Field

This field shows measurement types and results. The measurement type is displayed in the top line. The test result value of that measurement appears in the bottom line.

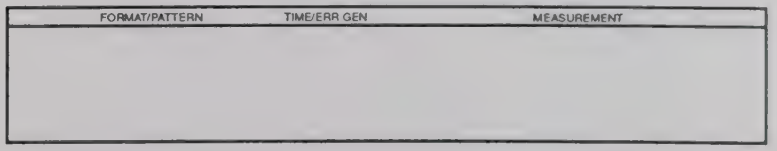



**Figure 2-4**
**Front Panel Display**

## 2.4 CONTROL TYPES

There are three types of controls on the 5108's main panel:

1. Menu Keys
2. Display Keys
3. Action Keys

### 2.4.1 Menu Keys

Menu keys each select the value of one parameter. Each key has an associated *LED panel menu* (see Fig 2-5). Pressing the key cycles through the choices on the menu, with each LED lighting to show the current selection. Only one value can be selected at a time. These menus are actually part of the front panel and should not be confused with the various menus that can be shown on the main display.

**Note:** If a selection is inappropriate for the current unit setup, that selection's LED will flash.

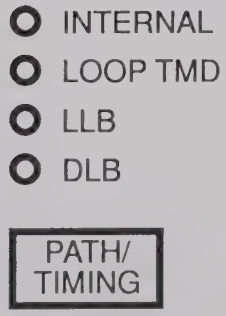



**Figure 2-5**
**Example Menu Key Control**

### 2.4.2 Display Keys

Display keys select the values of parameters on the main display. Most of these controls consist of two arrow keys and a corresponding field in the main display (see Fig 2-6). Unless menus are being displayed or special functions are being executed, the parameter's current value is shown in its field. Pressing an Up or Down display key cycles the screen display to a new value for that parameter.

The AUX FCTNS, STORE and RECALL display keys consist of a single key that calls a specific function menu to the main screen, and then executes a command based on a menu selection. Auxiliary menus take up the entire display until a selection is made. The Right and Left SELECT keys cycle the "*" cursor through the menu to identify the item to be selected. To execute the selection, press ENTER.

If you enter a bad parameter, the digit that needs to be corrected to make the parameter valid flashes. You must change the digit and then re-enter the parameter.

Pressing and holding any menu or display key continuously cycles through all of that key's selections.

### 2.4.3 Action Keys

Action keys initiate immediate action when pressed. For example, pressing the SPEAKER Up or Down arrow keys immediately changes the speaker volume.

**Figure 2-6**
**Example Display Key Control**

## 2.5 CONTROL ORGANIZATION

The 5108's controls are arranged in nine groups. The function of each group is described in Table 2-2. The 5108's controls are described in detail in Section 4.

**Table 2-2**
**Control Groups Organization**

| Control Group | Function |
|---|---|
| **FORMAT** and **PATTERN** | Selects transmit and receive line rate, framing format, and test pattern. |
| **TRANSMITTER/ RECEIVER SETUP** | Selects line code, transmit timing and source of transmit signal. Also turns Auto Setup feature on and off. |
| **ERROR INJECT** | Determines transmitted error ratio and type. |
| **TIME/ERR GEN** | Determines what is shown in the middle section of the main display. Most items in the display relate to time (elapsed time, duration of test, etc.). The last item is transmitted error ratio. |
| **INTERFACE** | Determines which interface (DSX, LINE, or PROBE) is selected. Also used to determine LBO and to send CSU or user-programmed loopback activate and deactivate codes. |
| **TEST RUN** | Determines basic operating mode of 5108 and starts and stops tests. AUX FCTNS calls up the auxiliary functions menu. |
| **CATEGORY**, **MEASUREMENT**, and **SCAN** | Selects which measurement result is shown in right-hand section of the display. |
| **DATA ENTRY** and **SELECT** | Selects menu choices and edits certain items shown in the main display. |
| **REPORTS** | Determines which types of reports are enabled. Also used to print Quick Reports. |

## 2.6 INPUT/OUTPUT CONNECTORS

All of the 5108's signal connectors are mounted on the front panel for easy accessibility. These connectors include a DS1 input and output (T1C optional), a wander reference input (wander optional), a network line interface, a Remote-control/ Serial Printer port, and a Parallel Printer port (see Sec 4.11).

## 2.7 INDICATORS (LEDs)

The 5108's LEDs are color-coded according to their function as follows:

**Amber** Panel menu selections. These LEDs indicate which item has been selected on a panel menu.

**Green** Activity. Green LEDs include Test RUN and PULSES, and light when these are active.

**Red** Take notice. These indicate an error state, Test Run is Off, or Reports Enable is Off.

You can tell the status of a test quickly and easily by referring to the front-panel LEDs.

## 2.8 TONES

The 5108 emits an audible tone when certain events occur. To raise or lower the tone's volume, press the Up or Down SPEAKER keys to the left of the main display. The following events will trigger a tone:

- Pattern errors
- CRC-6 errors
- Frame errors and OOF
- BPV and excess 0's
- Invalid Key Entries

The unit also sounds a "click" tone to confirm any key being pushed during normal operation. Tones rise in frequency during periods of high error rates.

# 3. Applications

## 3.1 USING A PRINTER

The 5108 has two ports that will drive a printer: a serial (RS-232) port and a parallel port. These enable you to use the 5108 with printers that have either an RS-232 or parallel (centronics-type) interface.

Both 5108 ports may also be used *simultaneously* to:

1. Drive two printers, one serial and one parallel, or
2. Drive a local parallel printer while using the RS-232 port for remote control or remote printing.

### 3.1.1 Turning Reports On and Off

The 5108 generates four types of reports using a printer: Summary, Event, Messages, and Setup (see Sec 4.9). The REPORTS ENABLE menu key on the right side of the front panel enables these types of reports as follows:

| | |
|---|---|
| **OFF** | No reports are sent to the printer. |
| **SUMMARY** | Only summary reports are sent to the printer. This can be useful to limit the number of reports generated during high error periods. |
| **EVENT** | Only event reports and messages are sent to the printer. This is useful when performing real-time troubleshooting. |
| **ALL** | Summary reports, event reports, and messages are enabled. |

Setup reports are issued independently of Summary and Event reports. See Section 4.9.

### 3.1.2 Customizing Summary Reports

Summary Reports consist of a core section and five optional sections. Complete Summary Reports contain a great deal of

data and not all of it may be needed for certain tests. You can maximize the readability of reports and save paper by excluding any or all of the optional sections (see Sec 6.4).

### 3.1.3 Port Setup and Cables

You can use either a parallel or RS-232 (serial) printer to output reports from the 5108.

#### 3.1.3.1 Parallel Printers

The parallel port requires no special setup. The 5108's DB25 (25-pin, female) connector receives standard printer cables used to connect IBM-compatible PCs to parallel printers.

**Note:** Connect the printer to the parallel port before turning on the 5108 to avoid a print function "freeze."

#### 3.1.3.2 RS-232 (Serial) Printers

The set up of the 5108's RS-232 (serial) port depends on the configuration of the printer you are going to use. The following must be considered:

| | |
|---|---|
| **BAUD RATE** | The 5108 RS-232 port operates at standard baud (transmission) rates of 300, 1200, 2400, 4800, and 9600 bits per second. |
| **STOP BITS** | The RS-232 port operates with either one or two stop bits. Normally one bit is selected. |
| **PARITY** | The 5108's port operates with parity checks of ODD, EVEN, or NONE. Normally NONE is selected. |
| **CABLE** | The type of cable depends on the printer. See Section 8.3 for pinout and cabling information. |
| **BITS PER CHARACTER** | Depending on the printer, 7 or 8 bits per character. |

**Note:** When interfacing the 5108 with printers or terminals through the RS-232 port, consider the 5108 to be a DCE-type device.

### 3.1.4 Using the Optional Seiko Printer:

To use the 5108 with the optional Seiko DPU411-11BU printer, make sure that both devices are configured identically. Refer to page 6 of the Seiko *DPU-411 Instruction Manual* for information on configuring the printer. Table 3-1 shows a typical DPU-411 configuration.

**Table 3-1**
**Seiko DPU-411 Printer Setup**

| Switch | | Setting | Function |
|---|---|---|---|
| DIP01 | SW1 | Off | Selects Serial input |
| | SW2 | On | Auto line feed |
| | SW3 | On | 40 column format |
| | SW4 | On | Regular characters |
| | SW5 | Off | Zero form = Ø |
| | SW6 | Off | |
| | SW7 | On | US character set |
| | SW8 | On | |
| DIP02 | SW1 | On | 8 bits per character |
| | SW2 | On | No parity |
| | SW3 | — | Not applicable |
| | SW4 | Off | |
| | SW5 | Off | 9600 Baud |
| | SW6 | Off | |

Use the Auxiliary Functions OTHER_SETUP menu to configure the 5108's RS-232 port to match the Seiko's settings as follows (see Secs 6.6 and 6.6.2):

```
BAUD RATE   STOP BITS   PARITY   SIZE   DUPLEX
  9600          1       NONE     8      HALF
```

## 3.2 REMOTE CONTROL

Through its RS-232 port, the 5108 may be controlled from an external terminal such as a Texas Instruments Silent 700-type printing terminal, or by an external controller, typically a personal computer.

If the terminal or PC is near the test set, you can use a simple RS-232 cable to connect the terminal to the test set. If the terminal is located away from the test site, modems are required. For good response use at least a 1200 baud modem.

For remote control applications, consider the 5108 to be a DCE-type device.

Any function that can be performed from the 5108's front panel may also be performed by remote control. Typical remote control applications are:

1. Allowing an experienced operator or technician to assist the technician on the scene, or
2. Long-term surveillance using a PC to collect, store and analyze the data.

Control programs for the 5108 may be written in many computer languages such as BASIC, PASCAL, or C. Typically, a series of PRINT statements are used to send 5108 commands from the PC to the test set while READ statements recover data from the test set.

5108 remote control commands, responses, and command syntax are found in Section 8.2.

## 3.3 EXAMPLE PROCEDURES

This section contains operating procedures for 5108 example applications. In all examples it is assumed that:

1. The 5108 has been powered up (see Sec 2.1), and
2. The unit is locally controlled, not remotely controlled.

Assumptions are made in each example regarding line code, framing format, test duration and other parameters. The procedures may be modified to accommodate other situations.

For detailed information on Jitter/Wander measurement and test procedures, call 1-800-TAU-TRON and ask for Application Notes Numbers 15, 16, and 17.

### 3.3.1 Example 1: Continuous In-service Performance Testing

In this example the 5108 is used to monitor a DS1 signal from a DSX-1 Monitor Jack or equivalent access point in a continuous (untimed) measurement mode. See Figure 3-1.

**Assumptions:**

1. Tested signal has live traffic (*not* a known test pattern).
2. Framing format = SF.
3. Line code = AMI.

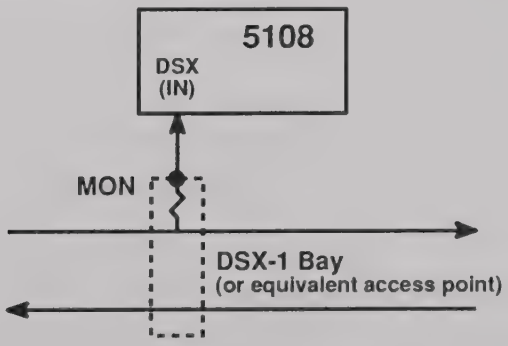



**Figure 3-1**
**In-service Performance Test**

**Procedure:**

1. Connect a 310 or Bantam patch cord from the Monitor jack to the 5108 DSX IN jack.

   The 5108 DSX input Automatic Gain Control (AGC) circuit automatically adjusts to monitor-level or full-strength DS1 signals.

2. Verify 5108 is in STOP mode. Press RUN/STOP if the RUN LED is lit.

3. Press RECALL.

   `SETUP 0` is flashing in the display screen.

4. Press ENTER.

   This loads Setup #0 which is the factory setting.

5. Change the pattern by pressing Down PATTERN once. The test set should then be set as follows:

   FRAMING FORMAT = DS1 SF
   PATTERN = LIVE
   LINE CODE = AMI
   MEAS MODE = CONT

6. Press RUN/STOP to start test.

   The 5108 now runs a continuous (untimed) test. Event reports, front panel indicators and the audio alarm alert you when errors are detected. A summary report is printed when you terminate the test.

7. The Setup #0 default measurement display is

   `FRAME: ERRORS`

   Use the MEASUREMENT Up and Down keys to display other FRAME measurements. FRAME bit measurements are the most important live traffic error measurement when the framing format is SF.

When framing format is ESF, CRC-6 measurements are more useful. Use the CATEGORY and MEASUREMENT keys to view measurements in other categories.

8. Press RUN/STOP to stop the test.

   To print an intermediate summary report during a test press QUICK REPORT.

### 3.3.2 Example 2: Timed In-service Performance Testing

This example is the same as Example 1 except that the 5108 performs a *2-hour timed test.* See Figure 3-1 (page 19).

**Assumptions:**

Same as Example 1.

**Procedure:**

1. Repeat steps 1 through 5 in Example 1.

   Setup #0 is loaded and modified.

2. Press MEAS MODE until SINGLE is selected.

   The 5108 is now ready to run a single timed test.

3. Press the TIME/ERR GEN Up and Down keys until TEST FOR appears in the display. The factory default test duration is 1 hour:

   ```
   00-01:00:00
   ```

4. Press ENTER (EDIT) to get into edit mode

   The hours digit (1) flashes.

5. Use the INCR/DECR keys to change the `TEST FOR` value from 1 to 2 hours.

6. Press ENTER to confirm the new value.

   2 in `TEST FOR` value stops flashing.

7. Press RUN/STOP to start test.

The 5108 now runs a 2-hour test. After two hours the unit automatically terminates the test and prints a Grand Summary Report showing the data collected during the test.

### 3.3.3 Example 3: 1-hour DS1 Path Test

In this example the 5108 tests a DS1 path which has been looped at the far end to allow single-ended testing. The return signal is monitored for Pattern (logic) errors which give a true indication of round-trip error performance. The 5108 is set up to perform *1-hour repeat tests* until manually stopped. See Figure 3-2.

**Note:** If the path is complex (contains one or more multiplexed sections) Pattern errors may be detected without detecting any BPVs because BPVs are not propagated through multiplexers. Detecting Pattern errors but no BPVs indicates that the trouble is not in the incoming direction of the local line.

**Assumptions:**

1. Framing Format = SF.
2. Line Code = AMI.

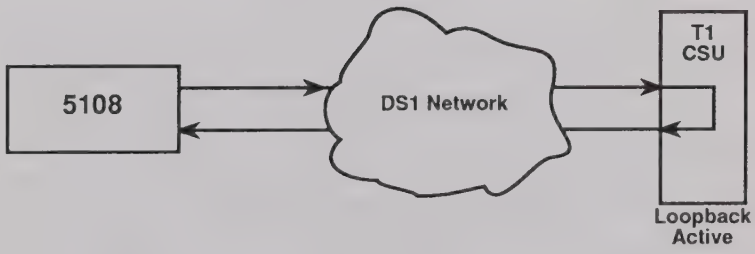
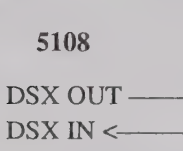



**Figure 3-2**
**DS1 Path Test**

**Procedure:**

1. Using 310 or Bantam patch cords, connect the 5108 as follows:




**Note:** Make sure the far end is looped. The 5108 can be used to activate and deactivate the loop.

The 5108 can be used to activate and deactivate CSU or NI loopbacks using either standard CSU loop codes or user-programmed codes. See Sections 4.5.3, 4.5.4, and 6.6.3 for more information.

2. Press RECALL.

   `USER 0` flashes in main display.

3. Press ENTER.

   Setup #0 is loaded.

4. Press MEAS MODE until the REPEAT LED is lit.

   The default test time is 1 hour.

5. Press REPORT ENABLE until the ALL LED is lit.

6. Press RUN/STOP to start test.

   Summary reports are generated every hour. Event reports are generated as errors are detected.

7. Press RUN/STOP to stop test.

### 3.3.4 Example 4: Automatic Testing

The 5108 has two powerful features, AUTO SETUP and AUTO RUN, that allow you run tests automatically, with the unit automatically configuring itself and starting the test. See Figure 3-3.

**Assumptions:**

1. Line code will be AMI or B8ZS.
2. Frame format will be SF, ESF, or Unframed.
3. Patterm will be QRW or Live.

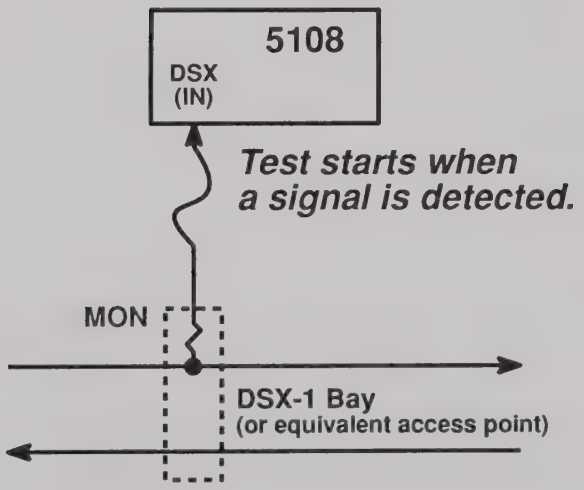



**Figure 3-3**
**Automatic Testing**

**Procedure:**

1. Press the AUTO SETUP key so that its LED lights.
2. Press MEAS MODE so that AUTO is selected.
3. Press RUN/STOP.

   The RUN LED should flash. The unit is now standing by to automatically begin a continuous (untimed) test.

4. Apply signal to be tested.

   The 5108 auto-configures to match the signal and then starts testing after auto-configuring (see Sec 4.2.1).

5. Remove signal.

   The unit stops testing when the signal is withdrawn. It starts testing again as soon as a signal is applied.

These features are also a good way to quickly find the type of DS1 signal at a DSX-1 monitor jack or other access point.

# 4. Front Panel Reference

## 4.1 FORMAT AND PATTERN

These controls select the DS1 framing format and test pattern. See Figure 4-1.

### 4.1.1 FORMAT

This is a display key control located below and to the left of the main display. Use it to select one of five formats. The selected format is indicated in the upper line of the main display's Format/Pattern field. 5108 formats include:

| | |
|---|---|
| **DS1 SF** | DS1 SuperFrame, or "D4" format. |
| **DS1 ESF** | DS1 Extended SuperFrame. |
| **DS1 SLC96** | DS1 SLC-96-type format. $F_t$ (terminal framing) bits only. |
| **DS1 UNFR** | DS1 patterns at 1.544 Mbps with *no* framing bits inserted. |
| **T1C UNFR** | T1C patterns at 3.152 Mbps with *no* framing bits inserted. T1C option must be installed, see Section 2.1. |

**Note:** SLC-96 is available for Receive only.

The transmit side outputs all zeros for the derived data link.

**Figure 4-1**
**FORMAT and PATTERN**

### 4.1.2 PATTERN

This is a display control. Use it to select one of 10 patterns to be generated by the pattern generator, and detected by the pattern receiver. In loopback modes (DLB, LLB), this control only applies to the pattern receiver (for error measurement purposes) because the transmitted signal is derived from the received signal. Pattern error detection occurs in all cases except when a live pattern is selected.

PATTERN selections are displayed on the lower line of the main display's Format/Pattern field and include those shown in Table 4-1.

**Table 4-1**
**Pattern Selections**

| PATTERN | DESCRIPTION |
|---|---|
| **QRW** | Also called QRS or QRSS, this is the standard quasirandom word ($2^{20}$–1 PRBS w/14-zero constraint). |
| **2E23 PRBS** | $2^{23}$–1 pseudorandom bit sequence. |
| **2E20 PRBS** | $2^{20}$–1 pseudorandom bit sequence, same as QRW but without 14-zero constraint.<br>**Note:** the 2E23 and 2E20 PRBSs contain long strings of 0's and so are only suitable for use with B8ZS line coding. |
| **2E15 PRBS** | $2^{15}$–1 pseudorandom bit sequence. |
| **ONES(1/1)** | An all-ones (one-out-of-one) pattern. In unframed mode, this is the same as an AIS event. |
| **1/2** | Alternating 1's and 0's (1:1) [F0101...]. |
| **1/8** | A one-out-of-eight pattern (1:7) [F01000000]. |
| **3/24** | A three-out-of-24 pattern (3:21) [F010001000000000000000100]. |
| **USER** | A user-programmable word (2–24 bits) The first bit on the left of the display is transmitted after the framing (F) bit. |
| **LIVE** | When this is selected, the 5108 doesn't look for pattern errors on the received signal, and transmits the default QRW. In LIVE, the unit displays N/A for each measurement in the pattern category. |

## 4.2 TRANSMITTER/RECEIVER SETUP

This control group configures the Transmitter and Receiver line code, transmitter timing, and loopback parameters (see Fig 4-2). The selected line code applies to both the transmitter and the receiver.

### 4.2.1 AUTO SETUP

This is an action key that controls the Auto Setup function. In Auto Setup mode, the 5108 automatically determines the line code (AMI or B8ZS), frame format (SF, ESF, or Unframed *only*), and pattern (QRW or Live *only*) at the start of each test. While AUTO SETUP is active, these parameters may not be set manually.

The AUTO SETUP feature can help you get ready to test more quickly (see Sec 3.3.4).

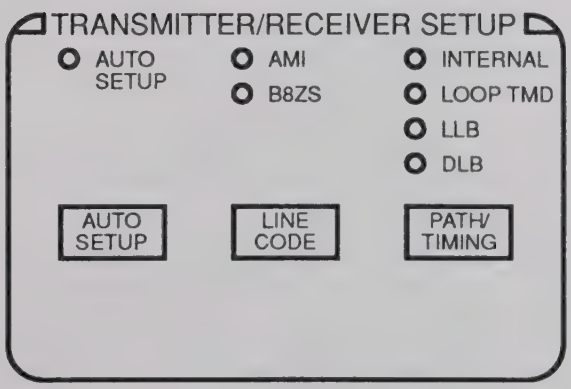



**Figure 4-2**
**TRANSMITTER/RECEIVER SETUP Group**

#### 4.2.1.1 Format and Pattern Search:

Auto Setup mode searches for SF, ESF, or Unframed formats and QRW or Live patterns only.

In Auto Setup mode, when a signal is connected to the 5108's DSX or LINE/PROBE input ports, the display will read SEARCHING for both Format and Pattern. The 5108 internally begins its search for SF or ESF frame format. SEARCHING is still displayed for Format and Pattern and remains until a format or a pattern is found.

If SF or ESF is not found the 5108 internally sets Format to unframed (UNFR) and begins searching for a QRW pattern. If a QRW pattern is detected, the 5108 will set and display UNFR for Format and QRW for Pattern. If a QRW pattern is not detected, Pattern is set to LIVE. The display continues to show SEARCHING for Format until a frame format is detected.

While the 5108 displays SEARCHING and LIVE, internally the unit is still searching for a frame format and a QRW pattern. If the signal changes such that SF or ESF is found, the 5108 automatically sets and displays that format. If a recognizable QRW is detected, the 5108 sets and displays QRW.

When a frame format is found or, if unframed, a QRW is found, the search process stops.

If the data pattern or frame format changes or becomes corrupted enough to cause a Loss of Signal, Out of Frame, and/or Loss of Pattern Synchronization for 2.5 seconds the 5108 will stop the current test, restart the test, and begin the search for Format and Pattern again. This restart has the same effect as a Stop/Run function in Manual mode (see Section 4.6.2). For this reason it may not be desirable to use Auto Setup mode for long-term testing. At the restart time the RUN LED lights and the status indicators are cleared.

**Note:** If an AIS signal is detected at the start of Auto Setup, no test will be performed. The AIS status LED lights and the display is AIS DETECTED. The RUN LED blinks.

#### 4.2.1.2 Line Code Search:

Auto Setup mode searches for AMI or B8ZS only.

If the 5108 receives a signal whose line code cannot be determined, it does not display an active line code and any excess zeros events are suppressed. Internally, the 5108 is set to B8ZS. If multiple B8ZS code words are received, a status bit is triggered and the B8ZS Line Code LED lights. Excess zeros events are no longer suppressed, and the Excess Zeros threshold is set to 8.

If multiple occurrences of eight or more consecutive zeros are received, the internal B8ZS excess zeros asserts a status bit to signal that condition. The 5108 sets and displays AMI because 8 or more zeros are not allowed in a B8ZS coded signal. Once the code has been determined, excess zeroes events are no longer suppressed.

### 4.2.2 LINE CODE Key

This menu key selects the 5108's line code configuration. Press this key to toggle between AMI (Alternate Mark Inversion), and B8ZS (Bipolar with 8-zero substitution). The B8ZS decoder is disabled when AMI is selected.

### 4.2.3 PATH/TIMING

This menu key selects the transmitted signal and timing source. Press this key to cycle through the following:

**INTERNAL** **Internal**. The normal mode of operation. Transmit framing, pattern, and timing are internally generated.

**LOOP TMD** **Loop Timed**. The signal is internally generated, but transmit timing is derived from the recovered clock of the 5108 receiver.

**LLB** **Line Loop Back**. Loopback occurs at the line level (1.544 Mbps in DS1, 3.152 Mbps in T1C) so the 5108 acts as a line repeater with + and – pulses transmitted as received. The unit is transparent to all error types, including BPVs. Transmit clock is based on the recovered clock. Only BPVs can be injected in this mode. **Note:** BPVs can overwrite a B8ZS code word which causes bit errors.

**DLB** **Data Loop Back**. Loopback occurs at the data (payload) level: 1.536 Mbps for DS1 Framed, 1.544 Mbps for DS1 Unframed, and at the line level (3.152 Mbps) for T1C. Payload bits are looped, but framing bits and line code are internally generated. Only payload logic errors are passed. Transmitter clock is derived from receiver input, and signaling states are preserved.

## 4.3 ERROR INJECT GROUP

These controls let the 5108 generate single errors or continuous error ratios for a selected error type (see Fig 4-3).

### 4.3.1 ERROR TYPE

This menu key allows you to select one of four error types (the 5108 only generates one error type at a time):

| | |
|---|---|
| **PATTERN** | Pattern (logic) bit errors. |
| **CRC-6** | ESF CRC-6 code errors. |
| **FRAME** | Framing bit errors.<br>**Note:** inserts $f_t$ and $f_s$ errors in SF, $f_t$ errors in SLC-96, F-bit errors in ESF. |
| **BPV** | Bipolar Violations. Does not violate B8ZS coding except when in Line Loop Back (LLB) mode. |

### 4.3.2 SINGLE

This is an action key that works as a manual error injector. Pressing Single injects a single occurrence of the selected error type into the transmitted signal.

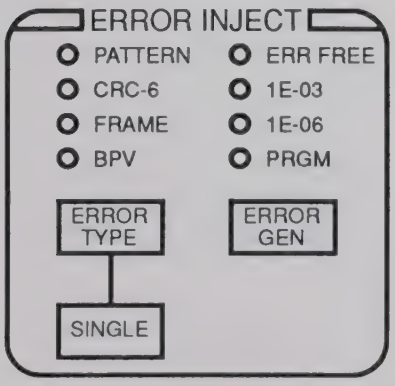



**Figure 4-3**
**ERROR INJECT Group**

### 4.3.3 ERROR GEN (error generation)

This is a menu key that lets you configure the error ratio as one of the following:

**ERR FREE** No continuous error ratio is generated. Single errors may be injected with the SINGLE control.

**1E–03** A continuous error ratio of $1 \times 10^{-3}$. Not available in T1C.

**1E–06** A continuous error ratio of $1 \times 10^{-6}$.

**PRGM** User-specified error ratio over the following ranges:

$1 \times 10^{-9}$ to $1 \times 10^{-3}$ for DS1

$1 \times 10^{-9}$ to $5 \times 10^{-4}$ for T1C

Use the TIME/ERR GEN display key control to view and edit the PRGM programmable error ratio. Press Up or Down to move through the menu categories and select Error Gen. The error ratio is presented in the format M E-X, where M is the mantissa of the error ratio, and X is the absolute value of the error ratio exponent. Use INCR and DECR to edit the values (see Sec 4.8.2).

M may be set to either 1 or 5. X may be set over the range $3 \leq X \leq 9$. However, the ratio entered must be within the line rate's range (shown above).

## 4.4 TIME/ERR GEN (Timing & Error Generation)

This is a display key control located under the Time/Err Gen field of the main display (see Fig 4-4). Pressing the Up or Down keys cycles through a category of setup parameters that includes time related selections and the current error generation ratio.

Each category is described below. Items that can be changed using EDIT, SELECT, and INCR/DECR are labeled "may be edited." With testing stopped, press ENTER and then use SELECT and INCR/DECR to adjust the values of the items, and ENTER again to confirm them.

### 4.4.1 Test Interval

(days, hours, minutes, seconds). Defines the duration of single or repeated tests.

```
TEST FOR
DD-HH:MM:SS
```

*may be edited*

### 4.4.2 Elapsed Time

(days, hours, minutes, seconds). Shows the time elapsed since the beginning of the current test.

```
ELAPSED
DD-HH:MM:SS
```

Elapsed Time is reset at the beginning of each RUN period.

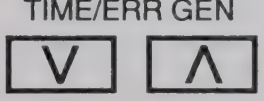



**Figure 4-4**
**TIME/ERR GEN**

### 4.4.3 Time Remaining

(days, hours, minutes, seconds). Shows time remaining for the current test.

```
REMAINING
DD-HH:MM:SS
```

In a continuous test, the display reads:

```
REMAINING
FOREVER
```

### 4.4.4 Time of Day

(hours, minutes, seconds). Displays the current time of day.

```
TIME
HH:MM:SS
```

*may be edited*

Time is expressed in 24-hour format. All values can be changed one digit at a time over the following limits:

| | |
|---|---|
| HH | 00–23 |
| MM | 00–59 |
| SS | 00–59 |

### 4.4.5 Date

(year, month, day). The current date.

```
DATE
YYYY MMM DD
```

*may be edited*

The year is a four-digit number (1989, etc); the month is a three-letter abbreviation (JAN, FEB, etc); and the day a one or two-digit number (01—31).

All numbers may be changed one digit at a time. The month may be adjusted using the Data Entry group's INCR/DECR keys to cycle through the abbreviations.

### 4.4.6 Error Generation Ratio

Displays the current error generation ratio in the format:

```
ERROR GEN
M E-X
```

*may be edited*

M, the mantissa of the ratio, may be set to either 1 or 5.

X, the absolute value of the error ratio exponent, may be set over the range $3 \leq X \leq 9$.

**Note:** The ERR GEN ratio must be within the selected line rate's specified range:

1E-09 to 1E-03 for DS1
1E-09 to 5E-04 for T1C.

When ERROR FREE is selected the word OFF is displayed as the current ERR GEN ratio.

When the ERR GEN control is set to PRGM, the displayed error ratio may be edited (see Sec 4.3.3). The programmed value is stored and will return whenever PRGM is selected.

The two front-panel ERROR GEN ratios, 1E-03 and 1E-06, may not be edited.

## 4.5 INTERFACE GROUP

This group configures the 5108's DSX and LINE/PROBE interface ports to suit the type of tests being performed (see Fig 4-5). It also configures the LINE LBO and generates CSU and programmable loopback codes.

### 4.5.1 INTFC SELECT (interface select)

This menu key selects either the DSX or LINE/PROBE interface. Only one or the other may be selected. The appropriate panel indicator, located above its respective interface connector, lights to show which input is active.

INTFC SELECT also selects the LINE/PROBE's input gain depending on whether the input is LINE or PROBE.

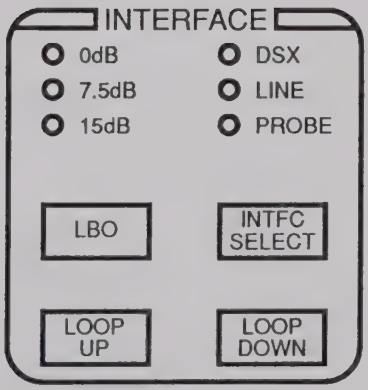



**Figure 4-5**
**INTERFACE Group**

Pressing the INTFC SELECT key cycles through the following selections:

**DSX** DSX interface is selected.

**LINE** LINE/PROBE (line) interface is selected. The 5108 equalizes up to 22.5 dB of cable loss. Not selectable in T1C mode.

**PROBE** LINE/PROBE (probe) interface is selected. Input performance is identical to LINE except that 20 dB of gain is added to allow use of the 5108's high-impedance Bridge Probe (see Sec 8.4). Maximum cable equalization remains 22.5 dB. No transmit signal is available. Not selectable in T1C mode.

For best performance, avoid having a signal present at both the DSX and LINE/PROBE interfaces at the same time regardless of which is selected.

### 4.5.2 LBO (line build out)

This menu key selects the line build out (LBO) used at the LINE/PROBE interface. Press this key to cycle through the panel menu which includes:

**0 dB** The LINE/PROBE interface output signal is a nominal DSX-1 (3 V-pk) signal with no attenuation.

**7.5 dB** An LBO simulating a cable length with a loss of 7.5 dB at 772 kHz is inserted in series with the LINE/PROBE interface output.

**15 dB** A 15 dB LBO is inserted in the LINE/PROBE interface output.

The LBO key is only active when INTFC SELECT is set for LINE or PROBE.

### 4.5.3 LOOP UP

This is an action key that triggers a T1 Channel Service Unit (CSU) in-band loop activate (Loop Up) signal, or a user-programmed Loop-Up signal. The user-programmed signal must be enabled using Auxiliary Functions (see Sec 6.6.3).

If the user-programmed loop pattern is set to OFF, pressing LOOP UP sends a 1/5 pattern (1000010000 . . .) with the currently selected framing-bit sequence overwriting the pattern. If the user-programmed pattern is *ON*, the pattern sent will be the bit sequence defined in Auxiliary Functions with framing bits overwriting the pattern. In either case, the 5108 display shows:

```
TRANSMITTING      LOOP UP DETECTED?
  LOOP UP                NO
```

The 5108 generates the Loop Up code until one of the following occurs:

- An existing loopback is detected
- A loopback is activated and detected by the 5108
- Ten seconds elapses with no loopback detected.

If the 5108 detects loopback activation (normally after five seconds) then LOOPBACK DETECTED changes to YES.

If an existing loopback is detected (loopback detected within three seconds), then the 5108 displays the following message:

```
PRE-EXISTING LOOP DETECTED
LOOP UP CODE NOT TRANSMITTED
```

The 5108 stops transmiting the Loop Up code within three seconds if there is already a loopback present.

If loopback activation is not confirmed, the 5108 stops transmitting the Loop Up code after about ten seconds.

### 4.5.4 LOOP DOWN

This is an action key that triggers a T1 Channel Service Unit (CSU) in-band loopback deactivate (Loop-Down) signal, or a user-programmed Loop-Down signal.

If the user-programmed loop pattern is set to OFF, press LOOP DOWN to send a 1/3 pattern (100100. . .) with the currently selected framing-bit sequence overwriting the pattern. If the user-programmed pattern is *ON*, the pattern sent is the bit sequence defined in Auxiliary Functions with framing bits overwriting the pattern. In either case, the 5108 display shows:

```
TRANSMITTING      LOOP DOWN DETECTED?
  LOOP DOWN              NO
```

The 5108 continues to transmit the Loop Down code until one of the following occurs:

- Loopback deactivation occurs and is detected (verified) by the 5108
- Loopback deactivation is not confirmed by the 5108 after ten seconds.

If the 5108 detects that loopback deactivation has occurred, LOOP DOWN DETECTED changes to YES.

If Loopback stays active, LOOP DOWN DETECTED remains NO for the length of the code transmission (about ten seconds). NO indicates that deactivation has not yet occurred and the loopback is still present.

Before sending the Loop Down code, the 5108 tests the circuit to see if there is an exisiting loop. If the 5108 doesn't detect loopback it still transmits the code but displays:

```
TRANSMITTING      LOOP DOWN DETECTED?
  LOOP DOWN          NOT VERIFIABLE
```

Both the LOOP UP and DOWN controls are disabled during tests to prevent accidental test interruption.

## 4.6 TEST RUN

This group configures the measurement mode, test start and stop, remote control, and auxiliary functions (see Fig 4-6).

### 4.6.1 MEAS MODE (measurement mode)

This is a menu key that selects the 5108's measurement timing mode. Press this key to cycle through the following selections:

**CONT** A continuous, untimed measurement is performed in RUN mode. Tests must be manually stopped by the operator.

**SINGLE** One timed measurement is performed in RUN mode. Test stops automatically

**REPEAT** Reoccurring, timed measurements of equal duration are performed in RUN mode. Previous test results are held for approximately 8 seconds.

**AUTO** A continuous test starts automatically when a signal is detected and stops when the signal is removed.

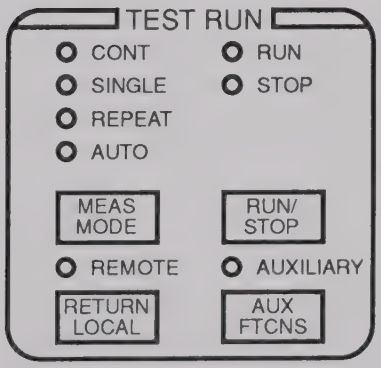



**Figure 4-6**
**TEST RUN Group**

### 4.6.2 RUN/STOP

This is a menu key with two selections:

**RUN** (START TEST) Clears all error counts in preparation for new test, starts test, then accumulates new error counts until end of test period. RUN flashing indicates that AUTO measurement mode has been armed but no input signal has been detected.

**STOP** (STOP TEST) Testing stops. Error counting stops. All counts are frozen until the 5108 is again put into RUN mode.

**Note:** In RUN mode, no changes that affect measurement can be made. Line code, frame format, pattern, and measurement interval are locked while a test is running. Pressing a locked control triggers a warning tone.

Controls that display or print results but do not affect measurement, such as CATEGORY, MEASUREMENT, QUICK REPORT, etc, are active in RUN mode. The HISTORY RESET control may be used in run mode also.

ERROR INJECT controls may be used while a test is running, but the PRGM error ratio may not be edited.

### 4.6.3 RETURN LOCAL

This action key returns the 5108 from remote control to normal front-panel operation. In Remote mode, all of the front-panel controls except for the RETURN LOCAL key are inactive, and the unit is externally controlled. The 5108 *automatically* enters remote mode when a command is received through the RS-232 port (see Sec 8.2).

The REMOTE indicator light is on when the unit is in Remote mode, and off when the unit is in Local mode.

A complete list of the Remote Control commands is given in Section 8.2.

### 4.6.4 AUX FCTNS (auxiliary functions)

This is a display key that calls up the auxiliary functions menu:

```
*SCHEDULING      PRI_SETUP   REPORT INTVL
 REPORT FRMT     USER PAT    OTHER_SETUP
```

To choose menu items, first move the cursor (*) to indicate the item you want using the left and right SELECT keys, and then press ENTER.

All auxiliary functions must be performed while the 5108 is in STOP mode.

The specific auxiliary functions are described in detail in the Auxiliary Functions section (Section 6) of this manual.

## 4.7 CATEGORY, MEASUREMENT, AND SCAN

These three display controls determine which measurement results are displayed (see Fig 4-7). Use them to choose the error category and measurement type you want to see on the screen. These controls are active even during a test.

### 4.7.1 CATEGORY

Use the CATEGORY Up/Down keys to select the current error category. Each new category shows the measurement values for that category.

There are 10 measurement categories as shown in Table 4-2.

**Figure 4-7**
**CATEGORY, MEASUREMENT, and SCAN**

## Table 4-2
## Measurement Categories

| CATEGORY | DESCRIPTION |
|---|---|
| **PATTRN** | Pattern bit error measurements. |
| **CRC-6** | ESF CRC-6 error measurements. |
| **FRAME** | SF and ESF frame-bit and out-of-frame measurements and SLC-96 $F_t$ frame bits. |
| **BPV/0's** | Bipolar violations and excess zeros measurements. |
| **G.821** | CCITT G.821 calculations. The measurements are based on pattern, frame, and CRC-6 errors. |
| **SIGNAL** | T1/DS1 signal parameters such as level, frequency, etc. |
| **SLIPS** | Controlled (frame) and uncontrolled slip counts. |
| **ALARMS** | AIS, Yellow, AIS Sec, YL ALM Sec, Power Loss, and PWR LS Sec alarm counts. |
| **JITTER** | T1/DS1 Jitter measurements. N/A for T1C. Optional, see Sec 2.1. |
| **WANDER** | Wander related measurements (TIE and MTIE, etc). N/A for T1C. Optional, see Sec 2.1. |

### 4.7.2 MEASUREMENT

Use the MEASUREMENT Up/Down keys to cycle through the list of measurement values for a selected CATEGORY (see Sec 4.7.1). Table 4-3 lists the error categories, and the MEASUREMENT types available for each.

Definitions and further explanations of these measurements are given in Section 5.

**Table 4-3**
**Measurement Types**

| Category | Measurements Available | |
|---|---|---|
| **Pattern** | ERRORS | SEV ER-SEC |
| | AVG BER | CSES |
| | CUR BER | UAS |
| | ER-SEC | SYNC ES |
| | %EFS | LOSS SEC |
| **CRC-6** | ERRORS | SEV ER-SEC |
| | AVG BER | CSES |
| | CUR BER | UAS |
| | ER-SEC | SYNC ES |
| | %EFS | |
| **Frame** | ERRORS | LOF |
| | AVG BER | LOF SEC |
| | OOF SEC | |
| **BPV's/Excess 0's** | BPVs | SEV ER-SEC |
| | AVG BER | CSES |
| | CUR BER | UAS |
| | ER-SEC | EXSS 0 SEC |
| | %EFS | |
| **G.821** | UAS (PAT) | UAS (CRC) |
| | ES (PAT) | ES (CRC) |
| | SES (PAT) | SES (CRC) |
| | DM (PAT) | DM (CRC) |
| | UAS (FRM) | |
| | SES (FRM) | |

**Table 4-3***(cont)*
**Measurement Types**

| Category | Description | |
|---|---|---|
| **Signal** | DSX AMP<br>LINE LEVEL<br>FREQUENCY | LOSS SEC<br>SIMPLEX I |
| **Slips** | CTRLD<br>UNCTRLD | |
| **Alarms** | AIS<br>AIS SEC<br>YELLOW<br>YL ALM SEC | POWER LOSS<br>PWR LS SEC |
| **Jitter**<br>(optional<br>see Sec 2.1) | AMPLITUDE<br>HF AMP<br>HIT SEC<br>HF HIT SEC | CUR AMP<br>CUR HF AMP |
| **Wander**<br>(optional<br>see Sec 2.1) | TIE<br>MTIE<br>HIT SECONDS<br>EST C-SLIP | |

### 4.7.3 SCAN

This action key triggers a function that quickly and automatically scans key results in each measurement category, and displays only those with errors. The SCAN measurements consist of ER-SEC, SEV ER-SEC, and ALARM SEC error counts.

The SCANned error counts are displayed for about a second each. If there are no errors, the 5108 displays the message:

```
Scanning...No Troubles Found
```

in the Measurement field of the display. The 5108 continues scanning until you press SCAN again.

## 4.8 DATA ENTRY AND SELECT GROUP

This group controls the editing functions of many 5108 configuration parameters (see Fig 4-8).

### 4.8.1 SELECT

The SELECT left and right keys are display keys that move the screen cursor and are used to "point to" menu selections or to select a single digit or item in a parameter group for editing.

### 4.8.2 INCR and DECR (increment / decrement)

The INCR (Increment) up-arrow and DECR (Decrement) down-arrow keys are used to edit the currently selected item on the main display. For example, a selected digit may be INCRemented or DECRemented from 0 to 9, or the month field in a date display can be selected and INCRemented/ DECRemented from JAN through DEC.

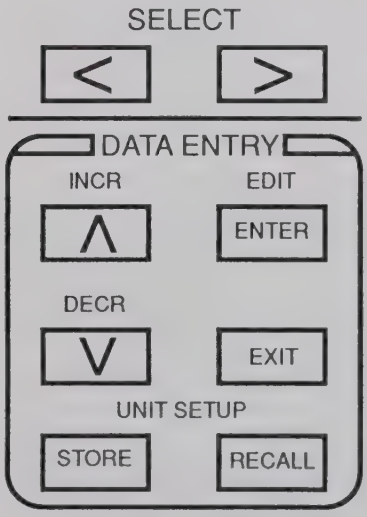



**Figure 4-8**
**DATA ENTRY Group with SELECT**

### 4.8.3 ENTER / EDIT

Press this action key to enable Edit mode, and to confirm and save edited values.

Press ENTER after making changes to items on the display. Items in a group may be edited, but the changes will not go into effect until they are confirmed by pressing ENTER. The ENTER key locks-in the changes and returns the test set to the previous menu.

### 4.8.4 EXIT

This is an action key used to leave an editing session *without* making any changes.

### 4.8.5 UNIT SETUP–STORE and RECALL

The 5108 can store and recall up to nine user-defined test setups, in addition to one factory-programmed setup that may not be edited. These setups are stored in non-volatile memory.

To store a unit configuration, first configure the 5108 the way you want it. When all the parameters are set, press STORE. This calls up the following menu in the measurement field of the main display:

```
Store Parameters
SETUP- 1
```

The digit after "setup" flashes to show that it is ready to be edited. Adjust the number from 1 through 9 using the INCR/ DECR keys to choose which user setup you want to store your configuration in. When you have made your selection press ENTER to execute the store command.

If there is already a configuration stored under a particular SETUP-number, the 5108 checks to see if you want to over-write it with the new one:

```
ENTER stores setup
EXIT  to abort
```

Press ENTER to overwrite the previously stored setup, or EXIT to leave the setup.

To recall a unit configuration from memory, press RECALL, which calls the following menu:

```
Recall Parameters
SETUP- 0
```

The digit flashes to show it is selected for editing. Press ENTER to select the factory-programmed setup (Setup-0), or use the INCR and DECR keys to select a user setup from 1 to 9. When you have chosen the setup you want, press ENTER to execute the Recall command and the unit will configure automatically.

## 4.9 REPORTS

This control group dictates what types of reports are printed (see Fig 4-9).

### 4.9.1 REPORT ENABLE

This menu key determines which automatic report types are active. The panel menu consists of:

| | |
|---|---|
| **OFF** | No automatic reports enabled. |
| **SUMMARY** | End-of-test Summary Reports enabled. |
| **EVENT** | Event Reports and Messages are enabled. |
| **ALL** | Summary Reports, Event Reports, and Messages are enabled. |

### 4.9.2 QUICK REPORT

Press this action key to print an immediate snapshot summary report during a test.

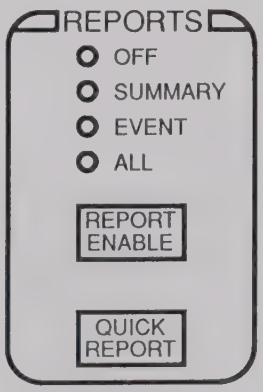



**Figure 4-9**
**REPORTS Group**

## 4.10 STATUS AND HISTORY INDICATORS

Status and History indicators include the LEDs in the upper right of the front panel (see Fig 4-10), and the PULSES indicators beside the DSX, WANDER REF, and LINE/PROBE input jacks.

When an indicator is off, its corresponding condition has not been detected. When an indicator is on, the condition is present. When an indicator is flashing (History state), the condition has occurred since the last reset, but is not occurring at that moment.

The HISTORY RESET key immediately resets all indicators. It does not affect error counts or other results. Indicators are also reset automatically when a new test is started.

Each of the conditions associated with the STATUS and HISTORY indicators are explained on the next page in Tables 4-4, 4-5, and 4-6.

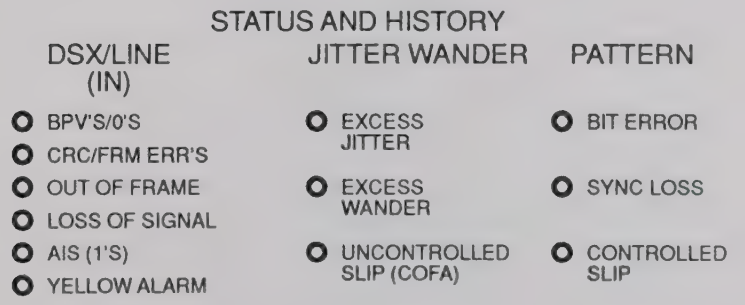



**Figure 4-10**
**Status and History Indicators**

**Table 4-4**
**DSX/LINE (IN) Indicators Group**

| CONDITION | DESCRIPTION |
|---|---|
| **BPV's/0's** | Bipolar Violation or Excess Zeros event. |
| **CRC/FRM ERR's** | CRC-6 errors or Frame Bit errors. |
| **OUT OF FRAME** | Out of Frame (OOF) threshold exceeded. Disabled in unframed modes. |
| **LOSS OF SIGNAL** | Loss of signal event. |
| **AIS (1's)** | Alarm indication signal. Disabled in unframed modes. |
| **YELLOW ALARM** | Yellow alarm detected. Disabled in unframed modes. |

**Table 4-5**
**JITTER/WANDER Indicators Group**

| CONDITION | DESCRIPTION |
|---|---|
| **EXCESS JITTER** | Occurrence of a jitter-hit second — a second in which jitter exceeds the jitter threshold (Either Total or HF jitter). |
| **EXCESS WANDER** | Indicates that the MTIE threshold has been exceeded. |
| **UNCONTROLLED SLIP** | (COFA) Indicates a change of frame alignment has been detected. |

**Table 4-6**
**PATTERN Indicators Group**

| CONDITION | DESCRIPTION |
|---|---|
| **BIT ERROR** | Pattern (logic) Errors. |
| **SYNC LOSS** | Pattern synchronization loss. |
| **CONTROLLED SLIP** | A controlled (frame) slip. |

### 4.10.1 PULSES Indicators

Pulses indicators are activity detectors that light when a signal is present at their respective input jacks. The indicators do not have a flashing history state like the STATUS AND HISTORY indicators, though intermittent input signals may make the PULSES indicators flicker.

There are three separate PULSES indicators. Their functions are described below.

| | |
|---|---|
| **DSX** | Indicates signal activity at the DSX input jack. Active only when the DSX input is selected. |
| **WANDER REF** | Indicates signal activity at the WANDER REF input jack. Active at all times, if Jitter/ Wander option is installed (see Sec 2.1). |
| **LINE/PROBE** | Indicates signal activity on the LINE/ PROBE input jack. Active only when LINE or PROBE input is selected. |

### 4.10.2 HISTORY RESET

This is an action key that resets all status and history indicators. Indicators that were in their History state (flashing) are turned off; indicators that were in their On state flash once and remain on if their condition is still present.

**Note:** HISTORY RESET does not affect error counts or other results.

## 4.11 INPUT/OUTPUT CONNECTORS

The input and output connectors on the 5108 Test Set consist of the following:

- DSX OUT (310- and Bantam-jack pair)
- DSX IN (310- and Bantam-jack pair)
- WANDER REF (310- and Bantam-jack pair)
- LINE/PROBE (RJ48C jack)
- RS-232 (female 25-pin DB25-connector RS-232 printer/ remote-control port)
- PARALLEL (female DB25-connector parallel port)

All of the connectors are on the lower part of the 5108's front panel for easy accessibility (see Fig 4-12).

**Note:** Only one jack in a 310- and Bantam-jack pair can be used at a time. The Bantam jack has priority and will disable the 310 jack if both are used simultaneously.

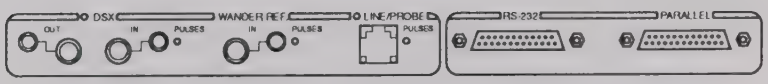



**Figure 4-11**
**Front-Panel Connectors**

### 4.11.1 DSX OUT

This 310- and Bantam-jack pair provides a DS1 output that conforms to ANSI Std T1.102-1987 DSX-1 recommendations for *new* equipment.

If the 5108 has the T1C option installed (see Sec 2.1), DSX OUT will also provide a T1C output per ANSI Std T1.102-1987 *DS1C* recommendations‡.

### 4.11.2 DSX IN

This 310- and Bantam-jack pair is the main DS1 measurement input. It accepts DS1, DSX-1 monitor-level, or T1C signals (T1C optional, see Sec 2.1) that conform to ANSI Std T1.102-1987 DSX-1 and DS1C recommendations.

**Note**: For best performance, avoid having a signal present at both the DSX and LINE/PROBE interfaces at the same time regardless of which is selected.

### 4.11.3 WANDER REF (wander reference)

This is a 310- and Bantam-jack pair used to make wander measurements. It accepts DS1 or DSX-1 monitor-level signals that conform to T1X1.4 recommendations. It is only operable with the Jitter/Wander option (see Sec 2.1). N/A in T1C.

### 4.11.4 LINE/PROBE

The LINE/PROBE Interface Input/Output RJ48C connector can be used instead of the DSX IN and OUT connectors, for DS1 signals *only*. LINE/PROBE is especially useful for testing the Network Interface (NI) at customer locations.

In LINE mode, this input terminates the line and provides simplex current loop. In PROBE mode (used with the 5108

‡ Overshoot ≤15% of amplitude

Bridging Probe, see Sec 8.4) 1000-ohm impedance is added. This allows signal access where monitor points are not available. LINE/PROBE is inoperable in T1C mode.

**Note:** Either the DSX or LINE/PROBE interfaces may be used, but not both at once. Use INTFC SELECT to choose the interface.

### 4.11.5 RS-232 Port

The RS-232C port may be used for remote control or a local printer, such as the Seiko DPU-411. This is a two-way port.

When interfacing the 5108 with printers or terminals through this port, consider the 5108 to be a DCE-type device in its implementation.

Some applications will require a special null-modem cable. For information on pinouts and cabling, see Section 8.3.

### 4.11.6 PARALLEL Port

This is a centronics-type, IBM PC-compatible, transmit-only (one-way) parallel port used to drive a local printer with a parallel interface (such as the Seiko DPU-411).

Connect the parallel printer to the parallel port *before* the 5108 is powered on. Connecting the printer while the 5108 is already on may cause the 5108's print function to "freeze."

# 5. Measurements & Reports

This section describes the types of measurements that are available through the 5108 (see also Sec 4.7).

## 5.1 GENERAL DEFINITIONS

The following general definitions are used to explain specific measurements in Sections 5.2 through 5.11.

### 5.1.1 Errored and Severely Errored Seconds

**Errored Seconds (ES)** are seconds in which one or more errors occur. **Severely Errored Seconds (SES)** are errored seconds in which enough errors have occurred to seriously impair service. The most common definition of an SES is a second in which the error ratio equals or exceeds $1 \times 10^{-3}$ but the error threshold is programmable on the 5108 using Auxiliary Functions (see Sec 6.6.1).

### 5.1.2 Consecutively Severely Errored Seconds

**Consecutively Severely Errored Seconds (CSES)** is a measurement that counts the number of contiguous SESs that have occurred. The CSES total is incremented by one count for every group of *three* contiguous SESs. If three contiguous CSESs occur (a total of *nine* contiguous SESs) then the CSES total stops incrementing and on the *tenth* contiguous SES, the **Unavailable Seconds (UAS)** total starts incrementing beginning at ten (UAS = 10). The UAS total continues to increment until ten consecutive Non-SESs have occurred. These last ten Non-SESs are considered to be Available Seconds and are therefore not part of the UAS total.

If three contiguous CSESs are *not* counted, the UAS count does *not* begin. See Figure 5-1.

The Consecutively Severely Errored Seconds measurement applies to Pattern, CRC-6, and BPV errors.

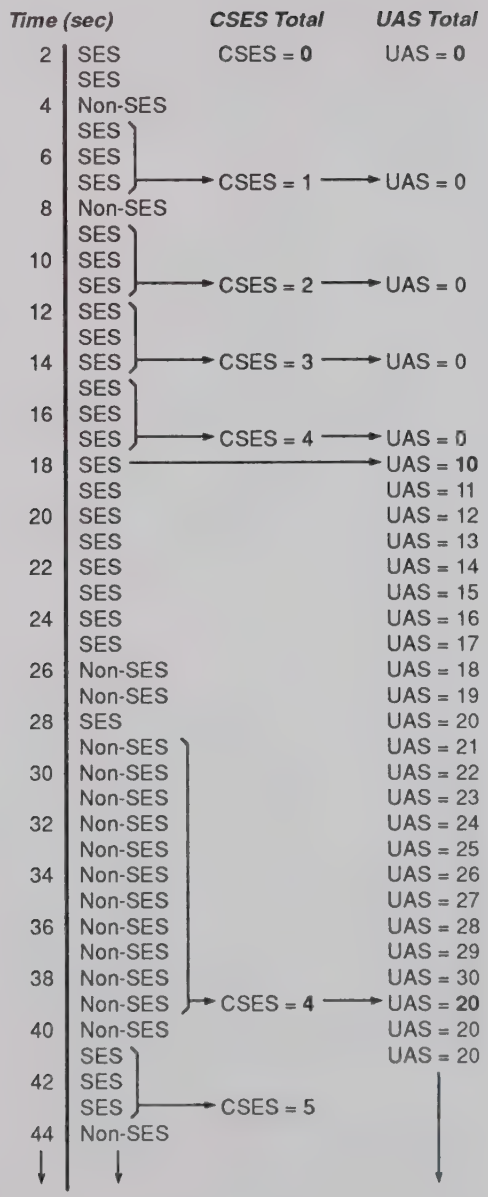



**Figure 5-1**
**Example CSES Measurement**

### 5.1.3 G.821 Available and Unavailable Seconds

G.821 Unavailable Seconds (UAS) are determined as follows:

- A signal is considered Unavailable or Failed after 10 consecutive SESs. The ten SESs are considered Unavailable Seconds.
- A signal is considered Available again after 10 seconds that are *not* Severely Errored Seconds. The ten non-SES are considered Available Seconds.

G.821 Available Seconds (AS) is the total number of seconds minus the total number of UAS.

### 5.1.4 G.821 Degraded Minutes

Degraded Minutes (DM) are determined by discarding all G.821 Unavailable and Severely Errored Seconds from a measurement period, grouping the remaining seconds into contiguous 60-second periods, and then determining which of these minute periods have an average Bit Error Ratio greater than or equal to the DM threshold of 1E-6 (not programmable).

### 5.1.5 Bit Error Ratios

Average Bit Error Ratios (AVG BER) are calculated using errors in all seconds, including Severely Errored and Unavailable Seconds.

Current BER (CUR BER) measurements are performed over rolling $1 \times 10^7$ bit periods (about 6.5 seconds for DS1 and 3.2 seconds for T1C).

### 5.1.6 Synchronous Errored Seconds

A Synchronous Errored Second (SYNC ES) begins when an error is detected and ends 1 second later. A new SYNC ES cannot be counted until the first SYNC ES ends. Because SYNC ESs begin at error detection, they are considered "synchronous" with error events.

## 5.2 PATTERN MEASUREMENTS

Measurements in this category are based on pattern errors (also called logic or bit errors) and pattern synchronization loss events (see Table 5-1). Measurements in this category are "N/A" if the selected pattern is LIVE.

**Table 5-1**
**Pattern Measurements**

| TYPE | DESCRIPTION |
|---|---|
| **ERRORS** | Pattern error count. |
| **AVG BER** | Average pattern BER. |
| **CUR BER** | Current pattern BER |
| **ER-SEC** | Pattern error second count. |
| **% EFS** | Pattern % error free seconds. |
| **SEV ER-SEC** | Seconds with more than *n* Pattern error events where *n* is set under aux. functions (range: 2—65,534). Default is 1,536. |
| **CSES** | Number of pattern Consecutively Severely Errored Seconds. |
| **UAS** | Number of pattern Unavailable or Failed Seconds. |
| **SYNC ES** | Number of *synchronous* pattern errored seconds. |
| **LOSS SEC** | Number of seconds in which loss of pattern synchronization was detected. |

## 5.3 CRC-6 MEASUREMENTS

The measurements in this category are based on Extended SuperFrame (ESF) error events (see Table 5-2). An ESF error event is an extended superframe‡ that contains a CRC-6 error event, an OOF event, or both. They may be thought of as ESF Path Errors. This category is "N/A" if DS1 format is not ESF.

CRC-6 measurements are not available for T1C.

**Table 5-2**
**CRC-6 Measurements**

| TYPE | DESCRIPTION |
|---|---|
| ERRORS | The total number of ESF error events. |
| AVG BER | Average ESF BER (ratio of ESF error events to total bits in measurement interval). |
| CUR BER | Current ESF BER. |
| ER-SEC | Number of ESF error event seconds. |
| % EFS | Percentage ESF error free seconds. |
| SEV ER-SEC | CRC-6 SES are seconds with more than *n* ESF error events (default 320) where *n* is set with AUX functions (range 2—333). |
| CSES | Number of ESF Consecutively Severely Errored Seconds. |
| UAS | Number of ESF Unavailable or Failed seconds. |
| SYNC ES | Number of synchronous CRC-6 errored seconds. |

‡ An extended superframe contains 24 frames of 193 bits each for a total of 4,632 bits. Each second contains 333 or 334 ESFs.

## 5.4 FRAME MEASUREMENTS

Measurements in this category are based on frame bit errors and Out Of Frame (OOF) events (Table 5-3). Frame measurements are primarily useful when SF Format is selected because measurements in this category indicate path error performance. Measurements in this category are "N/A" in unframed mode.

Frame measurements are not available for T1C.

**Table 5-3**
**Frame Measurements**

| TYPE | DESCRIPTION |
|---|---|
| ERRORS | Number of frame bit errors.<br>$f_t$ and $f_s$ for D4<br>$f_t$ for SLC-96<br>Frame alignment bits for ESF |
| AVG BER | The ratio of frame bit errors to frame bits. Frame BER is useful in estimating overall bit error rate on SF formatted DS1 paths. |
| OOF SEC | The number of seconds in which OOF events occur. |
| LOF | The number of Loss of Frame events. A Loss of Frame event begins after 2.5 seconds of OOF and ends after 2.5 seconds without OOF detection. |
| LOF SEC | The number of LOF seconds. |

## 5.5 BPV/0'S MEASUREMENTS

Measurements in this category are based on line code violations and relate to line performance. The category is called "BPV/0's" because bipolar violations and excess zeros are both line code violations (see Table 5-4).

**Table 5-4**
**BPV/0's Measurements**

| TYPE | DESCRIPTION |
|---|---|
| BPVs | The number of bipolar violations counted. |
| AVG BER | The average BER based on BPVs (the ratio of BPVs to total bits). |
| CUR BER | The current BER based on BPVs. |
| ER-SEC | The number of seconds containing a BPV *or* an Excess 0's event. This may be thought of as a *Line Error Second*. |
| % EFS | The % of seconds with no line error events (*No* BPVs or Excess 0's events). |
| SEV ER-SEC | The number of line-severely-errored seconds. Line-severely-errored seconds are seconds in which the BPV Severely Errored Second count is exceeded.<br>The SES threshold is programmable using aux. functions over the range 2—65,534. The default value is 1,544. |
| CSES | Number of line Consecutively Severely Errored seconds. |
| UAS | Number of line Unavailable or Failed seconds. |
| EXCESS 0 SEC | The number of seconds in which excess consecutive 0's events were detected (≥16 for DS1 AMI, ≥33 for T1C AMI, ≥8 for B8ZS). |

## 5.6 G.821 MEASUREMENTS

Results in this category are based on CCITT reccomendation G.821 and shown in Table 5-5. The 5108 determines G.821 parameters based on Pattern Errors, CRC-6 Errors, and Frame Errors. G.821 measurements are not available in T1C mode.

**Table 5-5**
**G.821 Measurements**

| TYPE | DESCRIPTION |
|---|---|
| **UAS (PAT)** | Unavailable secs based on pattern errors. "N/A" if pattern is LIVE. |
| **ES (PAT)** | Errored Seconds counted in available time, based on pattern errors. "N/A" if pattern is LIVE. |
| **SES (PAT)** | Severely Errored Seconds counted in available time, based on pattern errors. "N/A" if pattern is LIVE. |
| **DM (PAT)** | Degraded minutes counted in available time, based on pattern errors. "N/A" if pattern is LIVE. |
| **UAS (CRC)** | Unavailable seconds based on CRC-6 errors. Available only in DS1 ESF format. |
| **ES (CRC)** | Errored Seconds counted, based on CRC-6 errors. Available in DS1 ESF format only. |
| **SES (CRC)** | Severely Errored Seconds counted in available time, based on CRC-6 errors. Available only in DS1 ESF format. |
| **DM (CRC)** | Degraded minutes counted in available time, based on CRC-6 errors. Available only in DS1 ESF format. |
| **UAS (FRM)** | Unavailable seconds based on frame errors. "N/A" for T1C. |
| **SES (FRM)** | Severely Errored Seconds counted in available time, based on frame errors or OOF events. "N/A" if unframed. |

## 5.7 SIGNAL MEASUREMENTS

Signal measurements (Table 5-6) are parametric measurements of the signal received at either the DSX or LINE/PROBE interfaces.

**Table 5-6**
**Signal Measurements**

| TYPE | DESCRIPTION |
|---|---|
| **DSX AMP** | The average peak amplitude of the signal appearing at the DSX input. Signal amplitude is expressed in Volts peak. **Note:** This measurement is labeled "N/A" when the LINE input is selected. |
| **LINE LEVEL** | The average peak amplitude of the signal appearing at the LINE input. Line Level is expressed in dBdsx, or dB below a nominal DSX signal (3.0 volt pk). This measurement is "N/A" when the DSX input is in use. **Note:** If the signal level is below the input squelch threshold (Pulses LED is off), the 5108 displays "too low." |
| **FREQUENCY** | The measured bit rate of the monitored signal in Hz. The 5108 has a range of ±4000 ppm for T1C (optional) and DS1. If the signal is outside these limits, the 5108 displays "Out Of Range." |
| **LOSS SEC** | The number of seconds in which a LOS event has been detected. A LOS event is declared when the input signal level falls below a squelch threshold for more than 150 ms. During a LOS event, no error measurements are valid. **Note:** A LOS event is different from an excess 0's event. LOS is based on signal *level* while excess 0's is based on the number of consecutive 0's |
| **SIMPLEX I** | The simplex current measured at the Line Interface (expressed in mA). This is "N/A" when the DSX input is active. |

## 5.8 SLIPS MEASUREMENTS

Controlled slips can be detected in framed PRBS or QRW patterns and are declared when 192-bit sections of a monitored PRBS or QRW are deleted or repeated. Controlled slips actually cannot be detected on live traffic, although its TIE measurement capability (see Sec 5.11) gives the 5108 the ability to *estimate* controlled slips.

An uncontrolled slip is a repetition or deletion of a section of a DS1 signal that is *not* a 192-bit DS1 frames. Uncontrolled slips result in a shift in the framing bit position, which is called a Change Of Frame Alignment (COFA). They are "N/A" if the signal is unframed. The 5108 records an Uncontrolled Slip when it detects a COFA.

**CTRLD** The number of controlled slips detected. This measurement is labeled "N/A" when the current pattern is LIVE, or any of the fixed patterns: 1/1, 1/2, 1/8, 3/24, USER.

**UNCTRLD** The number of Change of Frame Alignments (COFAs). Each COFA is assumed to be the result of an uncontrolled slip. This is "N/A" when unframed.

## 5.9 ALARMS

This category contains alarm and alarm-second counts (Table 5-7). Alarm events are occurrences of a given alarm type and may last for more than one second. Alarm seconds are seconds in which the indicated alarm event takes place. It is possible for the number of alarm seconds to exceed the number of alarm events.

**Table 5-7**
**Alarm Counts**

| TYPE | DESCRIPTION |
|---|---|
| AIS | The number of Alarm Indication Signal (AIS) events. |
| AIS SEC | The number of AIS seconds. |
| YELLOW | Number of Yellow (remote) Alarm Events. Detected on framed SF or ESF signals. |
| YL ALM SEC | The number of Yellow alarm seconds. Only detected on framed SF or ESF signals. |
| POWER LOSS | The number of times the 5108 has lost and recovered power. |
| PWR LS SEC | The number of seconds that the 5108 has been without power. |

**Note:** The power loss information applies only to power loss through means other than the 5108's front panel power switch. These events are only counted if the unit was running a test and power was lost.

## 5.10 JITTER MEASUREMENTS (optional)

**Note:** To make jitter measurements, the Jitter/Wander option must be installed in your 5108. See Section 2.1.

This category contains measurements based on DS1 jitter (see Table 5-8), defined as DS1 signal phase variation *above* 10 Hz. The 5108 measures true peak-to-peak jitter which is the difference between the most positive and most negative instantaneous peak jitter amplitudes in a measurement period. This measurement is "N/A" in T1C.

Jitter is expressed in Unit Intervals (UI). One T1/DS1 Unit Interval is the duration of a single DS1 bit (1/1.544 MHz, or 648 ns).

**Table 5-8**
**Jitter Measurements**

| TYPE | DESCRIPTION |
|---|---|
| **AMPLITUDE** | Peak-to-peak total jitter (10Hz—40kHz), evaluated over the entire measurement interval. |
| **HF AMP** | Peak-to-peak high-frequency jitter (8—40 kHz), evaluated over the entire measurement interval. |
| **HIT SEC** | The number of seconds in which total jitter exceeds the Jitter Threshold set under aux. functions. |
| **HF HIT SEC** | The number of seconds in which high-frequency jitter exceeds the High-Frequency Jitter Threshold set under aux. functions. |
| **CUR AMP** | The total jitter amplitude measured during the last second. |
| **CUR HF AMP** | The high-frequency jitter amplitude measured during the last second. |

## 5.11 WANDER MEASUREMENTS (optional)

**Note:** To make these measurements, the Jitter/Wander option must be installed in your 5108. See Section 2.1.

This category contains measurements based on DS1 wander (see Table 5-9), defined as DS1 signal phase variation *below* 10 Hz. The 5108 measures the relative wander between the signal monitored at the DSX or LINE/PROBE interface, and the WANDER REF (wander reference) interface. Wander is measured in *microseconds*. Wander measurment is "N/A" in T1C mode.

Wander is Time Interval Error (TIE). Network wander specifications are expressed in Maximum Time Interval Error (MTIE). MTIE is the difference between the most positive and negative TIE values during the measurement interval. Therefore, MTIE is true peak-to-peak wander. By measuring MTIE and jitter, the 5108 provides a full-spectrum view of signal phase variation.

**Table 5-9**
**Wander Measurements**

| TYPE | DESCRIPTION |
|---|---|
| **TIE** | The current value of TIE. |
| **TIE SEC** | The number of seconds in which TIE exceeded the MTIE threshold. |
| **MTIE** | Peak-to-peak TIE recorded over the measurement interval. |
| **HIT SECONDS** | The number of seconds where wander equals or exceeds the user threshold or G.811 threshold (see Sec 6.6.1). |
| **EST C-SLIP** | The estimated number of controlled slips based on TIE. |

## 5.12 REPORTS

When connected to a printer (see Sec 3.1), the 5108 can generate the following types of reports or messages:

| | |
|---|---|
| **Summary Reports** | Generated at the end of tests or at intermediate intervals if Interval Reports are turned On (see Sec 6.3). |
| **Event Reports** | Real-time reports generated by the detection of errors or other events. Identifies the time and date of errored seconds. |
| **Messages** | Generated when change-of-states occur, including Event Report Squelching and Alarms. |
| **Setup Report** | A specific report that shows the current configuration of the 5108 (see Sec 6.2). |

### 5.12.1 Summary Reports

Summary reports are issued at the end of report intervals and at the end of tests. A summary report issued at the end of a report interval is titled INTERVAL SUMMARY. This report includes results only for that interval, and not cumulative totals.

A summary report issued at the end of a test is titled GRAND SUMMARY.

Summary Reports may also be generated on demand using the QUICK REPORT key. These summary reports are titled SNAPSHOT SUMMARY and contain results starting from the beginning of the test.

The Summary Report are divided into sections which you may enable or disable with Auxiliary Functions (see Sec 6.4). This feature allows you to customize the Summary report. The first sections (the core of the report) cannot be disabled.

### 5.12.1.1 Summary Report Format

A summary report, whether Interval, Snapshot, or Grand, contains all parameters measured or calculated by the test set. It contains the following information (see Fig 5-2):

- Title, Date and Time, Period Start and Length.
- Unit Setup Summary.
- Total Error Count, ES, SES, CSES, Avg BER, and %EFS measurements for Pattern, CRC-6, Frame, and BPV categories.

The following sections are optional and can be enabled and disabled using the auxiliary functions.

- G.821, UAS, ES, SES, and DM measurements for Pattern, CRC-6, and Frame categories.
- Events; including the following:
  Signal and Pattern Loss Seconds
  Loss of Frame
  AIS
  Yellow Alarms and Seconds
  Controlled and Uncontrolled Slips
  Power Loss and Power Loss Seconds
  Excess Zeros Seconds
  OOF, LOF, and AIS Seconds
- Frequency and Amplitude Minimum and Maximum.
- Jitter and Hi-Frequency Jitter Amplitude and Hit Seconds. Only available if the Jitter/Wander option is installed (see Sec 2.1).
- Wander parameters: TIE, MTIE, Hit Seconds, and Estimated Controlled Slips. Only available if the Jitter/Wander option is installed (see Sec 2.1).

**Note:** The Frame line is not included in unframed mode tests, and CRC-6 is only included in ESF mode tests.

```
----------------------------------------
GRAND SUMMARY        1989 JAN 07 07:56:34
PERIOD START:             JAN 07 07:56:11
PERIOD LENGTH:               00-00:00:37

RUN/STP FORMAT     CODE PATTERN   PATH
STOP    DS1 ESF    B8ZS QRW       INTERN

MEAS. MODE  INTFC SEL  LBO    SETUP MODE
CONT        DSX        0 DB    MANUAL

ERRORS      COUNT      ES     SES     CSES
PAT         40482      13       2        0
CRC-6        1448       6       2        0
FRAME           0       0
BPV/0s       6185       6       0        0

ERRORS   AVG-BER    %EFS
PAT      1.3E-03    38.1
CRC-6    4.5E-05    71.4
FRAME    0.0E+00
BPV/0s   1.9E+04    71.4

G.821
ERRORS             UAS     ES   SES    DM
PATTERN              0     13     2     0
CRC-6                0      6     2     0
FRAME                0            5

EVENT                 EVENT
SIG LOSS SEC      0   EXC 0'S SEC       0
PAT LOSS SEC      2   OOF SEC           2
LOF               0   LOF SEC           0
AIS               0   AIS SEC           0
YELLOW            0   YELLOW SEC        0
CTRL SLIP         0   UNCTRL SLIP       0
PWR LOSS          0   PWR L SEC         0

PARAMETER           MIN          MAX
FREQUENCY       TOO_LO           0 ppm
AMPLITUDE      2.96 V pk    2.98 V pk

JITTER            AMPLITUDE      HIT SEC
TOTAL             5.50 UI p-p         10
HIGH FREQUENCY    0.02 UI p-p          0
OUT OF LOCK DURATION       0 sec

WANDER
TIE      0.00 us  MTIE   0.00 us
HIT SEC          0   EST C-SLIP        0
OUT OF LOCK DURATION       75 sec
----------------------------------------
```

**Figure 5-2**
**Example Summary Report**

### 5.12.2 Event Reports

Event Reports are printed for asynchronous seconds that are errored or severely errored, or that contain certain events. Specifically, Event Reports can be triggered by any of the following:

- Errored (event) seconds:
  CRC-6 (ESF error events)
  Pattern
  BPV
  Excess Zeros
  Frame
  Signal Loss
- Jitter/Wander hit seconds (optional):
  Jitter
  High Frequency Jitter
  Phase
- Measured slips:
  Controlled (Frame) Slips
  Uncontrolled Slips (COFA)

**Note:** Estimated Controlled Slips do *not* trigger event reports.

#### 5.12.2.1 Event Report Formats

An entry will be included only if the event it identifies occurs in the report's second. Each entry in the Event Report is described below:

**EVENTS** Lists all events that occurred in the second. Event types and their Event Report Abbreviations are shown in Table 5-10.

**Table 5-10**
**Events Abbreviations**

| EVENT | ABBREVIATION |
|---|---|
| Loss of Signal | LOS |
| Out of Frame | OOF |
| Excess Zeros | ZEROS |
| Loss of Pattern Sync | PSYNC |
| Jitter Hit (optional) | JITTER |
| High Freq. Jitter Hit | HFJIT |
| Controlled Slip | CSLP |
| Uncontrolled Slip | UCSLP |
| Event abbreviations appear on an event line in the order shown. | |

**ES** Lists all (non-severely) errored second types counted in this event second. ES types and the abbreviations that appear in event reports are shown below:

| *Event* | *Abbreviation* |
|---|---|
| PATTERN | PAT |
| CRC-6 | CRC6 |
| BPV/0 | BPV |
| FRAME | FRAME |

**SES** Lists all severely errored second types counted in the second. Error types (same as ES, above) reported as SES are *not* also reported as ES.

Each Event Report printout begins with a line including the date, time, and a title describing the event second. The title indicates the most serious (highest priority) event in that second. Report titles and associated events are listed on the next page from highest to lowest priority:

1. EVENT SECOND: Indicates a significant event has occurred. May also be either an ES or SES.
2. SEVERELY ERR-SEC: A severely errored second that does not contain any events.
3. ERRORED SECOND: An errored second but not a severely errored second, and does not contain any events.

If a second contains a PATTERN ES and a CRC-6 SES, the event report is titled SEVERELY ERRORED SECOND. If it contains an SES and an event it would be titled an EVENT SECOND. See example event reports below.

```
ERRORED SECOND              JAN 07  12:00:07
  ES     :  PAT=87  CRC=315

SEV ER-SEC                  JAN 07  12:00:08
  SES    :  CRC=333

EVENT SECOND                JAN 07  12:00:09
  EVENTS:  OOF  PSYNC
  SES    :  PAT=15250
  ES     :  CRC=126  FRAME=5
```

### 5.12.2.2 Squelching

Event Report Squelching reduces extra printouts during tests with heavy or intermittent error conditions. Event reports are squelched when there are 20 or more event printouts in the previous 60 seconds. The squelch is cancelled when there would have been five or fewer event printouts in the previous 60 seconds (had they not been squelched).

Squelching eliminates only event reports. Messages (Section 5.12.3) are unaffected by event report squelching.

### 5.12.3 Messages

Messages are issued independently of Event Reports and inform the operator of test set operation events such as TEST START, and operational problems such as power loss. Messages also indicate the start and end of alarm and event squelch periods. Messages include the time and date, and print the duration of the condition they report when that condition ends. They are issued only if EVENT reports are enabled.

Messages with their meanings and squelch rules follow:

#### 5.12.3.1 Power Lost, Power Restored

This pair of messages is issued after a power outage. Time and date of the power loss and power recovery are indicated. The POWER RESTORED message also includes total duration of the outage. Both messages are issued before any other report after power recovery. The formats are shown in the following example:

```
POWER LOSS                JAN 07 17:00:03

POWER RESTORED            JAN 07 17:30:15
                  DURATION = 000-00:30:12
```

#### 5.12.3.2 Test Start

This is issued at the start of a measurement, after RUN has been pressed. It is not issued at the start of each interval in a REPEAT test because the Summary Report issued at the end of each interval marks interval boundaries. Example:

```
TEST START                JAN 07  17:00:03
```

### 5.12.3.3 Alarm On, Alarm Off

Similar to POWER messages. This pair is issued for either AIS or YELLOW changes-of-state. Only changes-of-state are reported. OFF messages are accompanied by an event duration.

```
YELLOW ALARM ON                JAN 07 17:00:03
.
. (other messages/reports)
.

YELLOW ALARM OFF               JAN 07 18:00:03
                      DURATION = 000-01:00:00
```

### 5.12.3.4 Lost/Recovered Messages

This general class of messages indicates serious LOSS events:

- Jitter Out of Lock / Jitter in Lock. During periods of Jitter Out of Lock jitter measurements are invalid and Jitter Hit Second Events are squelched.
- Wander Out of Lock / Wander In Lock. Indicates Wander is out of lock and the condition's duration.
- Frame Lost (LOF) / Frame Recovered. Indicates periods of frame loss.
- Signal Lost (LOS). Indicates loss of signal (LOS) and the condition's duration.

Examples:

```
JITTER OUT OF LOCK          JAN 07  17:00:03
. (other messages/reports except jitter
.  and HF jitter hit seconds)
JITTER IN LOCK                 JAN 07 18:00:03
                      DURATION = 000-01:00:00

FRAME LOST (LOF)               JAN 07 17:00:03
.
.
FRAME RECOVERED                JAN 07 18:00:03
                      DURATION = 000-01:00:00
```

### 5.12.3.5 Squelch On, Off

These messages identify periods in which Event Reports are squelched because of excessive Errored or Severely Errored seconds.

Examples:

```
SQUELCH ON                    JAN 07 17:00:03
.
. (other messages)
.
SQUELCH OFF                   JAN 07 18:00:03
                    DURATION = 000-01:00:00
```

# 6. Auxiliary Functions

As discussed in the TEST RUN section, pressing the AUX FCTNS key calls up the Auxiliary Functions menu:

```
*SCHEDULING      PRI_SETUP   REPORT INTVL
 REPORT FRMT     USER PAT    OTHER_SETUP
```

Use the Left and Right SELECT keys to highlight the menu items, and confirm the choice by pressing ENTER.

The individual menu selections are described below.

## 6.1 TEST SCHEDULING (scheduling)

This function enables you to program the 5108 to run a test automatically at a specific time. Selecting SCHEDULING from the auxiliary functions menu calls up the following secondary menu:

```
Scheduled Start              Exit
HH:MM:SS                  To Abort
```

**Note:** The Scheduling function is enabled only when this menu is displayed. You must remain in the AUX SCHEDULING menu to use a timed test start.

The START time may be edited using SELECT, INCR/DECR, and ENTER. Press EXIT to disable and leave the function. The time is stored in non-volatile memory.

When the START time is entered, the current time shows in the middle of the display. When the START time is reached, the 5108 begins a test of the type selected using MEAS MODE.

All other testing functions and parameters are controlled in the normal manner, but they must be configured before the scheduled test time is set. If you press EXIT to leave auxiliary functions, the scheduled test is canceled.

## 6.2 PRINT SETUP (pri_setup)

This function prints out a hard copy of the 5108's current configuration, or a stored configuration (see Sec 4.8.5). Selecting PRI_SETUP from the AUX menu calls the following menu:

```
Setup Options To Print
STORED  0
```

The word STORED is flashing. Use INCR or DECR to toggle between STORED and CURRENT. These terms refer to the unit configuration information to be printed.

STORED allows you to print any of the setups in memory (0—9). Choose STORED and then press a SELECT key to highlight the number. You can INCR and DECR this number to choose which stored configuration to print. When you have made your selection, press ENTER to print it.

CURRENT prints the present unit setup. Choose CURRENT and press ENTER to print it. The number parameter is ignored when you choose CURRENT.

The printed report contains the following information (see Fig 6-1):

- Format, Line Code, Pattern, and Path
- Measurement Mode
- Interface Selection and LBO
- Setup Mode (Auto, Manual)
- Error Type, Rate, and Programmed Rate
- Screen Display
- User Programmed Pattern
- Report Mode and Printer Setup

```
-----------------------------------------
***SETUP - STORED 0

RUN/STOP FORMAT      CODE PATTERN    PATH
STOP     DS1 SF      AMI  QRW        INTERN

MEAS. MODE    INTFC SEL   LBO     SETUP MODE
CONT          DSX         0 DB     MANUAL

ERROR -  TYPE       RATE          PROG RATE
          PAT     ERR-FREE        1 E-5

DISP -   TIME          CAT     MEAS
        ELAPSED        FRM     ERRORS

PAT LEN    BIT PAT
24         110000000100000000000000

**THRESHOLD VALUES
SES - PAT       CRC       BPV
      1544     320        1544

**REPORT MODE = ALL
INTERVAL STAT     INTERVAL
OFF               00 - 00:15:00

G.821     EVENTS     SIGNAL
OFF       OFF        OFF

JITTER STAT   WAN STAT
OFF           OFF

BAUD  PARITY  DUPLEX    BITS - DATA  STOP
9600  NONE    HALF              8     1
-----------------------------------------
```

**Figure 6-1**
**Example PRI_SETUP Report**

## 6.3 REPORTING INTERVAL (report intvl)

This auxiliary function allows you to enable or disable Interval Reports (see Sec 4.9) and set the frequency (interval) of these reports. Selecting REPORT INTVL from the auxiliary functions menu calls up the following display:

```
Interval Reports    Interval
     OFF          DD-HH:MM:SS
```

OFF is flashing. Press INCR or DECR to change it to ON and enable interval reports. OFF disables them.

**Note:** Summary reports also must be enabled using the front-panel REPORT ENABLE key (see Section 4.9.1).

Report intervals can be set anywhere from 30 seconds to 99-23:59:59 days. Choose the digits you want to edit with SELECT and use INCR and DECR to set the interval you want. Press ENTER when you're done.

Interval summary reports contain data from the last report interval. If a 24-hour Single test is run with the Report Interval set to 1 hour, then 24 separate hourly interval summary reports are printed in addition to the Grand Summary report at the end of the 24-hour test.

**Note:** If the report interval is less than or equal to the test duration, then REPORT INTVL function is disabled.

## 6.4 REPORT FORMATTING (report frmt)

This function customizes the reports printed by the test set. Selecting REPORT FRMT calls the following display:

```
G.821 EVENTS SIGNAL JITTER WANDER
  OFF    OFF    OFF    OFF    OFF
```

The five menu items can be toggled between ON and OFF using SELECT and INCR/DECR. ON includes that section of the summary or interval report; OFF excludes it. For example, the following configuration:

```
G.821 EVENTS SIGNAL JITTER WANDER
  OFF    ON     OFF     ON     ON
```

would print out a report with Event, Jitter, and Wander summary data.

The Jitter and Wander selections are only included if your 5108 has the Jitter/Wander option installed (see Sec 2.1).

**Note:** The Summary section of a report is always included, even if these other sections are disabled.

The REPORT FRMT selections affect grand, interval, and snapshot summaries.

## 6.5 USER-DEFINED PATTERN (user pat)

This function allows you to program the User Pattern.

Selecting USER PAT from the menu calls up the following display showing the currently entered data pattern:

```
# of Bits     BIT PATTERN
   24         010001000000000000000100
```

Edit the display fields using SELECT to move the cursor, and INCR/DECR to adjust the length. Toggle the BIT PATTERN bits between 1 and 0.

The user-pattern length may be 2 to 24 bits, and is stored in non-volatile memory. The pattern remains in memory until it is re-edited. To exit pattern editing, press ENTER.

The USER PAT is synchronous with the transmit framing pattern. The left most bit is transmitted after the framing bit.

## 6.6 OTHER FUNCTIONS (other_setup)

This function lets you edit certain error thresholds, the RS-232C parameters, and define the custom loop codes.

Selecting OTHER_SETUP from the auxiliary function menu calls up a secondary menu:

```
THRESHOLDS        RS-232        LOOP-PATS
```

### 6.6.1 Thresholds

Selecting THRESHOLDS calls a third-level menu that allows you to edit error thresholds:

```
SEV ERR SEC     JITTER          WANDER
```

**Note:** The Jitter and Wander selections only appear if your 5108 has the Jitter/Wander option installed. See Section 2.1.

#### 6.6.1.1 Severely Errored Seconds Threshold

Selecting SEV ERR SEC generates a display which allows you to edit the Severely Errored Seconds Threshold:

```
Pattern   CRC-6    BPV
01536      320     01544
```

You can edit each selection above over the following ranges to determine when an SES is declared:

**Pattern** (pattern bit errors) 2—65,534
default is 1,536 (1E-3 ratio)

**CRC-6** (ESF error events) 2—333
default is 320 (1E-3 ratio)

An errored ESF contains either an OOF or CRC-6 violation.

**BPV** (bipolar violations) 2—65,534
default is 1,544 (1E-3 ratio)

A severely errored second of the appropriate type is declared when its corresponding threshold is exceeded.

### 6.6.1.2 Jitter (optional)

Selecting JITTER from the third level menu calls another menu with two editable jitter hit parameters:

```
JITTER THRESHOLD        TOTAL      HI-FREQ
                        5.0 UI     0.10 UI
```

TOTAL (10 to 40 kHz) and HI-FREQ (8 to 40 kHz) thresholds may be edited over the following ranges:

| | |
|---|---|
| Total | 0.1 to 9.0 (5.0 default) |
| Hi-Frequency | 0.05 to 0.90 (0.10 default) |

If either threshold is met or exceeded, then an excess jitter event is declared. The seconds in which jitter events occur are called Jitter Hit Seconds.

### 6.6.1.3 Wander (optional)

Network wander thresholds are expressed in terms of Maximum Time Interval Error (MTIE). The G.811 specification is a function of time; the user threshold is fixed.

Selecting WANDER from the third level menu calls the following display:

```
TYPE        USER THRESHOLD
G.811         001.00 us
```

Wander threshold TYPE may be set to either G.811 or USER. If G.811 is selected, the 5108 follows CCITT recommendation G.811 in determining excess wander. The G.811 MTIE threshold is a complex function of time, ranging from 1 ms after 10 seconds of observation to approximately 10 ms after 24 hours (For details see CCITT Recommendation G.811, "The Control of Jitter and Wander within Networks Based on the 1544 kbit/s hierarchy").

The USER threshold is fixed over time at a user-programmable value of MTIE from 0.08 to 99.99 µs.

Table 6-7 summarizes the Auxiliary Functions Other_Setup Thresholds.

**Table 6-1**
**Auxiliary OTHER_SETUP Thresholds Summary**

| Category | Selection | Range |
|---|---|---|
| SEV ERR SEC | Pattern | 2—65,534 errors |
| | CRC-6 | 2—333 errors |
| | BPV | 2—65,534 errors |
| Jitter (optional) | Total | 0.1—9.0 UI |
| | Hi-Frequency | 0.05—0.9 UI |
| Wander (optional) | User Threshold | 0.08—99.99 µs |
| | G.811 | not programmable |

### 6.6.2 RS-232 Port Setup

Selecting RS-232 from the OTHER_SETUP sub-menu allows you to configure the 5108's RS-232 port for use with external devices such as printers, dumb terminals, or personal computers. The 5108 displays the following menu:

```
BAUD RATE   STOP BITS    PARITY    SIZE     DUPLEX
  9600          1         NONE      8        HALF
```

These parameters may be set, using the SELECT and ENTER controls, as follows:

- BAUD RATE: 300, 1200, 2400, 4800, 9600
- STOP BITS: 1, 2
- PARITY: ODD, EVEN, NONE
- SIZE: 7 or 8 bits per character
- DUPLEX: Half or Full

For more information on using printers and remote control, refer to Sections 3.1, 3.2, and 8.2.

### 6.6.3 Custom LOOP Codes

The custom loop codes function allows user-programmed bit patterns to be transmitted when the front-panel LOOP keys are pressed. The user-programmed custom loop codes replace the default patterns for transmission when the function is set to ON (see Secs 4.5.3 and 4.5.4).

Selecting LOOP-PATS from the auxiliary functions OTHER_SETUP menu calls a display similar to the following:

```
User  Len  UP-Pat    Len  DN-Pat
Off    7   0000000    7   0000000
```

When USER is set to OFF, the front-panel LOOP UP and LOOP DOWN keys send their standard codes (see Sec 4.5). When USER is set to ON, the LOOP keys will send the patterns defined here in the LOOP-PATS menu.

To define the custom Loop-Up code, first define the number of bits in the pattern (Len). Use SELECT, INCR, and DECR to set the left "Len" from 2 to 8 bits. Use SELECT, INCR, and DECR to define a "UP-Pat" pattern by setting the pattern's bits to 0 or 1.

Define the custom Loop-Down code the same way as the Loop-Up code: press SELECT until the number under the right "Len" flashes. Use INCR/DECR to set this number from 2 to 8. Next use the SELECT, INCR, and DECR keys to edit the "DN-Pat" bit pattern.

When you have defined the custom loop codes, make sure they are enabled with USER set to ON. If USER is set to OFF, the front panel LOOP keys will send standard CSU loop codes. Press ENTER to lock-in the codes and return to the OTHER_SETUP menu.

The following LOOP-PATS configuration is an example of a loop activate/deactivate code for a Network Interface Connector. Note that some Network Interfaces may require unframed format for loop code transmission.

```
User  Len  UP-Pat   Len  DN-Pat
 On     5   11000     5   11100
```

The loop codes are saved every time the 5108 is depowered, and will reappear as programmed when the unit is repowered. To preserve several different custom loop codes for future use, save the 5108's configuration using STORE (see Sec 4.8.5).

# 7. Specifications

## 7.1 INTERNAL CLOCK

**Frequency**

| | |
|---|---|
| **DS1:** | 1.544 MHz ±5 ppm (±15 ppm 0—50°C) |
| **T1C:** | 3.152 MHz ±20 ppm<br>(T1C optional, see Sec 2.1) |

## 7.2 COMPATABILITY

| | |
|---|---|
| **Line Codes** | AMI, B8ZS |
| **Frame Formats** | SF (D4), ESF, SLC-96 (receive only), and Unframed |

## 7.3 PATTERNS

| | |
|---|---|
| **QRW** | 2E20-1 PRBS with 14-zero constraint |
| **PRBS** | 2E15-1, 2E20-1, and 2E23-1 pseudorandom bit sequences |
| **Short Patterns** | All Ones (1/1), 1/2, 1/8, 3/24 (synchronized with framing bit) |
| **Patterns** | User-programmable bit sequences (2—24 bits) |
| **Loop Codes** | In-band CSU loopback Activate (10000) and Deactivate (100) codes, or user-programmed codes, with framing bits overwriting patterns |

## 7.4 DS1 OUTPUT

| | |
|---|---|
| **Connectors** | One 310-compatible and one Bantam jack |
| **Waveform** | Per ANSI Std T1.102-1987 for DS1 signals |

## 7.5 DS1 INPUT

| | |
|---|---|
| **Connectors** | One 310-compatible and one Bantam jack |
| **Waveform Accommodation** | Per ANSI Std T1.102-1987 for DS1 signals |
| **Input Impedance** | 100 ohms ±5% |
| **Dynamic Range** | +6 to -26 dB relative to DSX-1 level |

## 7.6 T1C OUTPUT (optional, see Sec 2.1)

| | |
|---|---|
| **Connectors** | One 310-compatible and one Bantam Jack |
| **Waveform** | Per ANSI Std T1.102-1987 for DS1C signals (overshoot ≤15% of amplitude) |

## 7.7 T1C INPUT (optional, see Sec 2.1)

| | |
|---|---|
| **Connectors** | One 310-compatible and one Bantam jack |
| **Waveform Accommodation** | Per ANSI Std T1.102-1987 for DS1C signals |
| **Input Impedance** | 100 ohms ±5% |

## 7.8 LINE/PROBE INTERFACE (N/A for T1C)

| | |
|---|---|
| **Connector** | 8-pin (RJ-48C) |
| **Input Impedance** | 100 ohms ±5% |
| **Cable Equalization** | 0 to 22.5 dB (@ 772 kHz) |
| **Line Build Out** | 0, 7.5, and 15 dB (@ 772 kHz) |
| **Simplex Current Measurement** | 10 to 200 mA ±5% ±1 mA |

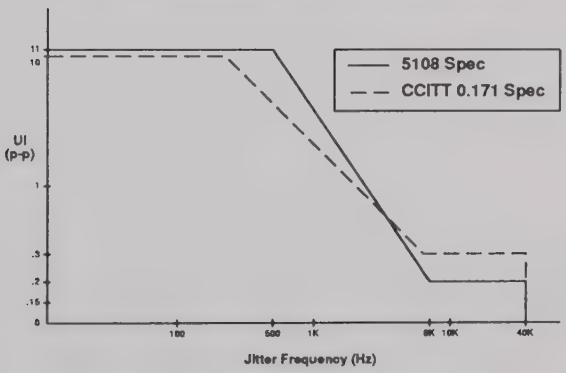
## 7.8 LINE/PROBE INTERFACE *(cont)*

| | |
|---|---|
| **Bridging Gain** | Nominal 20 dB gain required when using high impedance (1KΩ) bridging probe |

## 7.9 JITTER MEASUREMENT (optional, see Sec 2.1)

| | |
|---|---|
| **Accommodation** | Per CCITT recommendation 0.171 |
| **Accuracy** | ±0.035 UI ±5% |
| **Range** | Per CCITT recommendation 0.171 |
| **Measurement Filters** | Per CCITT and T1X1 recommendations; 10 Hz to 40 kHz and 8 kHz to 40 kHz (HF Jitter) |

**Jitter Tolerance and Measurement Range**




## 7.10 WANDER MEASUREMENT (optional, see Sec 2.1)

| | |
|---|---|
| **Reference** | Input dynamic range: +6 to -26 dB relative to nominal DSX-1 level |
| **Measurement Filter** | 10 Hz low-pass, single-pole (per T1X1 recommendations) |
| **Resolution** | 0.08 microseconds |
| **Accuracy** | ±0.12 microseconds |
| **Range** | ±999 microseconds |

## 7.11 GENERAL

| | |
|---|---|
| **Size** (HxWxD) | 6.5 x 15 x 6.8 inches<br>16.5 x 38.1 x 17.3 centimeters |
| **Weight** | 14 pounds<br>6.3 kilograms |
| **Environmental** | 32° to 113° F (0° to 45° C)<br>10–90% humidity, non-condensing |
| **Storage Temperature** | -40° to 167° F<br>-40° to 75° C |
| **Power** | AC: 115/230 Vac ±10%, 47 to 66 Hz<br>DC: -21 to -56 Vdc |

# 8. Appendices

## 8.1 CHECKING AND CHANGING THE FUSES

### 8.1.1 AC Fuse

The 5108's AC fuse is located on the rear panel in the upper part of the AC power connector. Pry the fuse holder partway out to remove the fuse.

Make sure the fuse is rated **1A, 115V, Slo-Blo**.

If the fuse rating is incorrect or the fuse is blown, replace it with a new, properly rated fuse. Insert the new fuse into the holder and press the holder back in. The fuse holder also holds a spare fuse for convenience. See Figure 8-1.

### 8.1.2 DC Fuse

The DC fuse is located on the rear panel next to the DC power terminals. Twist the fuse holder counterclockwise to remove the fuse.

Make sure the fuse is rated **3A, Slo-Blo**.

If the fuse rating is incorrect or the fuse is blown, replace it with a new, properly rated fuse. Insert the new fuse into the holder and turn it clockwise to tighten it into the unit. See Figure 8-1 (next page).

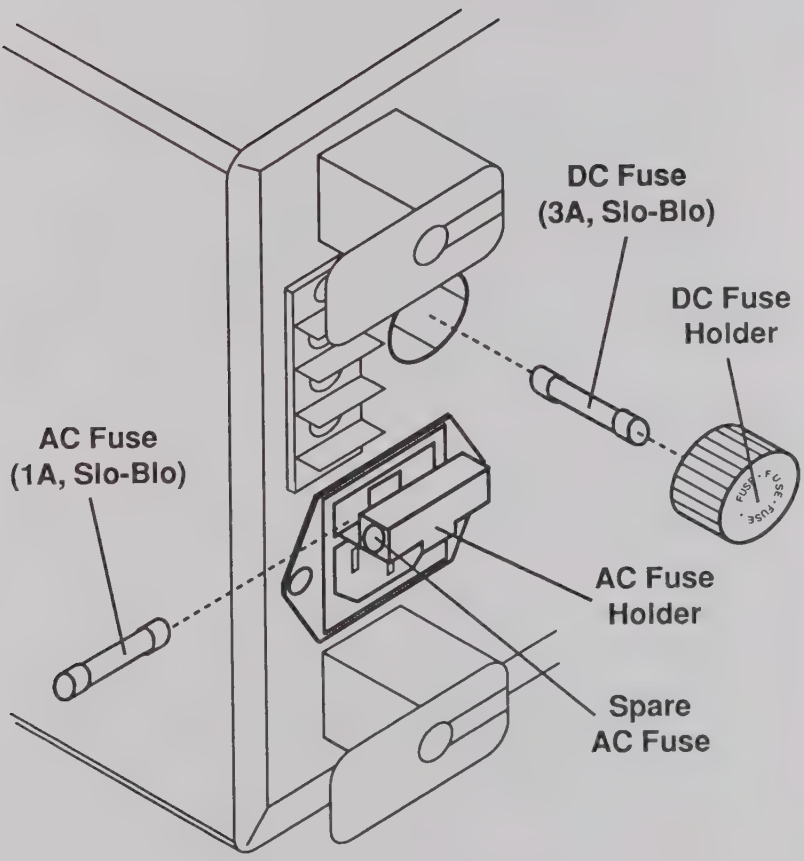



**Figure 8-1**
**Checking and Changing the Fuses**

## 8.2 REMOTE CONTROL COMMANDS

The Model 5108 can be remotely controlled through its RS-232 port by an external terminal or other device, such as a personal computer (see Sec 3.2). Note that the RS-232 port can also act as a printer port (see Sec 3.1). To differentiate between the two RS-232 modes, the 5108 has two separate states: Printer and Interactive.

### 8.2.1 RS-232 Printer State

When the 5108 is in its Printer state, all enabled reports are sent to the RS-232 and parallel ports.

### 8.2.2 RS-232 Interactive State

When the 5108 is connected to the external device, any carriage return <cr> received on the RS-232 port automatically puts the 5108 into its Interactive state. Press the front-panel RETURN LOCAL key or type "return to local" <cr> to disable the Interactive state.

When the 5108 is in its Interactive state it can be operated in one of two ways: Computer mode or Terminal mode. In Computer mode, the 5108 does not echo your typed commands. A douple prompt indicates that the last command has been processed. If the command was recognized and properly acted upon, the prompt will be ">>". If the command was not recognized or an error condition was encountered the prompt will be "??". To determine the error condition, examine the value of "Command Error" (see Table 8-1).

In Terminal mode, your typed commands are echoed and a prompt is issued to show that the last command has been processed. Error messages are displayed as text. To switch between modes, type:

```
REMOTE MODE = TERMINAL <cr>
              or
REMOTE MODE = COMPUTER <cr>
```

Table 8-1 summarizes the Computer mode error codes.

**Table 8-1**
**Error Codes, Computer Mode**

| Code Number | Definition |
|---|---|
| 0 | No errors since previous "Command Error" request. |
| 1 | Invalid parameter |
| 2 | Invalid command |
| 3 | Command was valid but could not be executed |
| 4 | Option is not installed |
| 5 | Cannot display this variable |
| 6 | Counter has overflowed |
| 7 | Invalid request |
| 8 | Command access not permitted |
| 9 | Valid only while test is in progress |
| 10 | Negative overflow |
| 11 | No previous LOOP command |
| 12 | Invalid user-setup number |
| 13 | Jitter or wander shows out-of-lock condition |
| 14 | Unit has not been calibrated. |
| 15 | Pre-existing loop detected. |
| 16 | Requested setup has not been stored. |
| 17 | Calibration error. |
| 18 | Value out of range. |
| Hardware error codes | |
| 128 | RS-232C parity error condition |
| 129 | RS-232C framing error condition |
| 130 | RS-232C receive buffer overrun |
| 131 | Receive queue has overflowed |

**Note:** The 5108 remebers only the first error condition encountered since the last "Error Command" execution.

Table 8-2 lists the 5108's remote control commands. They can be used in either Computer or Terminal mode.

### 8.2.3 Remote Command Entry

The software has automatic word completion, which means that you can abbreviate the commands by using only the first letter or letters of each word in that command. Abbreviate carefully to keep from entering the wrong command. In general, it is best to spell-out the whole command.

**Note:** The spaces between the words are still required when you use abbreviations.

In the TYPE column of Table 5-2, there are four possible entries: VAR, PAR, ACT, and ACT*. These specify the general format for using the commands (<cr> stands for Carriage Return). In the following examples, upper-case text represents operator entries and lower-case text represents the 5108's response.

#### 8.2.3.1 VAR (variable)

Type: *<command>* = <cr>

Response is the current value of that parameter.

Example: `>> ELAPSED TIME = <cr>`
returns the time elapsed since test start.

#### 8.2.3.2 PAR (parameter)

Type: *<command>* = <cr>

Response is the current value. Enter new value and <cr> to change it, or just <cr> to leave it unchanged.

Or

Type: *<command>* = *<new value>* <cr>

Values may be integer, exponential, or text.

PAR Examples: `FORMAT = <cr>`
returns the current format setting. Type *<new value>*<cr> or just <cr>.

```
>> FORMAT = <cr>
>> sf
>> FORMAT = ESF <cr>
```

sets format to ESF.

The *new value* parameter can be any of the valid values for that command's corresponding front-panel key.

**Note:** The equal sign (=) is optional when using a VAR or PAR command.

### 8.2.3.3 ACT (action)

Type: *<command>* <cr>

The action is immediately carried out.

Example: `>> LOOP UP <cr>`

transmits the CSU loop-up command.

### 8.2.3.4 ACT* (action with a parameter)

Type: *<command>* = *<parameter>* <cr>

The action is immediately carried out. This type of command differs from a PAR in that no value is returned.

Example: `>> RECALL = 1 <cr>`

recalls unit setup #1.

## Table 8-2
## Remote Control Commands

(Command parameter references are shown in parentheses)

| COMMAND | TYPE | FUNCTION |
|---|---|---|
| AIS EVENTS | var | AIS measurement. |
| AIS SECONDS | var | |
| AUTO SETUP | par | Acts as Auto Setup key (On, Off). |
| BPV AVERAGE BER | var | BPV measurements. |
| BPV CURRENT BER | var | |
| BPV ERRORS | var | |
| BPV ES | var | |
| BPV EXCESS ZERO SECONDS | var | |
| BPV SES | var | |
| BPV CSES | var | |
| BPV UAS | var | |
| BPV %EFS | var | |
| CALIBRATION DATE | var | Last calibration date. |
| CATEGORY | par | Select measurement category (Table 4-2). |
| COMMAND ERROR | var | Returns error code (Table 8-1). |
| CRC6 AVERAGE BER | var | CRC-6 Measurements. |
| CRC6 CURRENT BER | var | |
| CRC6 ERRORS | var | |
| CRC6 ES | var | |
| CRC6 SES | var | |
| CRC6 CSES | var | |

**Table 8-2 Remote Control Commands** *(cont)*

| COMMAND | TYPE | FUNCTION |
|---|---|---|
| CRC6 UAS | var | CRC Measurements (cont) |
| CRC6 SYNCHRONOUS ES | var | |
| CRC6 %EFS | var | |
| CURRENT SETUP | act | Print current 5108 configuration. |
| DATE | par | View/edit date (Sec 4.4.5). |
| DCL | act | Device clear. |
| DISPLAY | par | Selects category and measurement for viewing (Sec 4.7). |
| ELAPSED TIME | var | Displays Elapsed Time. |
| ERROR GENERATE | par | View/edit Err Gen choice (Sec 4.3). Acceptable parameters are OFF, 1E–3, 1E–6. Any other 1E-*n* entry is treated as PRGM. |
| ERROR TYPE | par | View/edit Error Type (Sec 4.3.1) Pattern, CRC6, Frame, BPV. |
| ESTIMATED CONTROLLED SLIPS | var | ECS measurements. |
| EXIT | act | Return to Local. |
| FORMAT | par | View/edit Format (Sec 4.1) |
| FRAME AVERAGE BER | var | Frame measurements. |
| FRAME ERRORS | var | |
| FRAME LOSS SECONDS | var | |
| FRAME LOSS EVENTS | var | |
| FRAME OOF SECONDS | var | |

**Table 8-2 Remote Control Commands** *(cont)*

| COMMAND | TYPE | FUNCTION |
|---|---|---|
| G.821 CRC6 DM | var | G.821 measurements. |
| G.821 CRC6 ES | var | |
| G.821 CRC6 SES | var | |
| G.821 CRC6 US | var | |
| G.821 FRAME SES | var | |
| G.821 FRAME US | var | |
| G.821 PATTERN DM | var | |
| G.821 PATTERN ES | var | |
| G.821 PATTERN SES | var | |
| G.821 PATTERN US | var | |
| HISTORY | act | Lists lit History LEDs and gives a status report. |
| INTERFACE | par | View/edit Line Input (Sec 4.5). |
| JITTER AMPLITUDE | var | Jitter measurements. |
| JITTER CURRENT AMPLITUDE | var | |
| JITTER CURRENT HF AMPLITUDE | var | |
| JITTER HF AMPLITUDE | var | |
| JITTER HF HIT SECOND | var | |
| JITTER HIT SECOND | var | |
| JITTER INSTALLED | var | Feature present Yes or No. |
| LBO | par | View/edit LBO (Sec 4.5). |
| LINE CODE | par | View/edit Line Code (Sec 4.2.2). |

**Table 8-2 Remote Control Commands** *(cont)*

| COMMAND | TYPE | FUNCTION |
|---|---|---|
| LLO | act | Local control lockout. |
| LLU | act | Unlock: undoes LLO. |
| LOOP STATUS | act | Reports on last Loop command. |
| LOOP DOWN | act | Sends selected Loop Down code. |
| LOOP UP | act | Sends selected Loop Up code. |
| LOOP DOWN PATTERN | par | Enter pattern (Sec 6.6.3) |
| LOOP UP PATTERN | par | Enter pattern (Sec 6.6.3) |
| LOOP USER | par | Enter On or Off (Sec 6.6.3) |
| MEASUREMENT | par | View/Edit measurements (Sec 4.7) |
| MEASUREMENT MODE | par | Acts as Meas Mode key (Sec 4.6.1). |
| MTIE | var | Returns wander MTIE value. |
| PATH | par | Acts as Path/Timing key (Sec 4.2.3). |
| PATTERN | par | View/edit Pattern setting (Sec 4.1.2, Table 4-1). |
| PATTERN AVERAGE BER | var | Pattern measurements. |
| PATTERN CURRENT BER | var | |
| PATTERN ERRORS | var | |
| PATTERN ES | var | |
| PATTERN %EFS | var | |
| PATTERN SES | var | |
| PATTERN CSES | var | |

**Table 8-2 Remote Control Commands** *(cont)*

| COMMAND | TYPE | FUNCTION |
|---|---|---|
| PATTERN UAS | var | Pattern measurements |
| PATTERN SYNCHRONOUS | var | |
| PATTERN LOSS SECONDS | var | |
| POWER LOSS EVENTS | var | Alarm measurements. |
| POWER LOSS SECONDS | var | |
| PULSES INTERFACE | var | Activity detectors. |
| PULSES WANDER | var | |
| QUICK REPORT SNAPSHOT | act | Generates summary report. |
| RECALL | act* | Recall setup (0–9). |
| REMAINING TIME | var | Displays time remaining. |
| REMOTE MODE | par | Change operation mode (Terminal, or Computer). |
| REPORT ENABLE | par | View/edit report mode (Sec 4.9). |
| REPORT FORMAT EVENTS | par | Edit report format (On, Off) (Sec 6.4). |
| REPORT FORMAT G.821 | par | On, Off. |
| REPORT FORMAT JITTER | par | On, Off. |
| REPORT FORMAT SIGNAL | par | On, Off. |
| REPORT FORMAT WANDER | par | On, Off. |

**Table 8-2 Remote Control Commands** *(cont)*

| COMMAND | TYPE | FUNCTION |
|---|---|---|
| REPORT INTERVAL | par | View/edit (Sec 6.3) (On, Off). |
| REPORT INTERVAL ENABLE | par | Turn interval reports On (Sec 6.3). |
| RESET | act | Acts as History key. |
| RESET RS232 | act | Resets interface parameters. |
| RETURN TO LOCAL | act | Emulates Return Local key. |
| REVISION | var | List software rev. number. |
| RS232 BAUD RATE | par | View/edit RS232 parameters |
| RS232 DATA SIZE | par | (Sec 6.6.2). |
| RS232 DUPLEX | par | |
| RS232 PARITY | par | |
| RS232 STOP BITS | par | |
| RTL | act | Return to Local. |
| RUN | act | Starts testing. |
| SIGNAL DSX AMPLITUDE | var | Signal measurements. |
| SIGNAL FREQUENCY | var | |
| SIGNAL FREQUENCY MAXIMUM | var | |
| SIGNAL FREQUENCY MINIMUM | var | |
| SIGNAL LINE LEVEL | var | |
| SIGNAL LOS EVENTS | var | |
| SIGNAL LOS SECONDS | var | |
| SIMPLEX CURRENT | var | |

**Table 8-2 Remote Control Commands** *(cont)*

| COMMAND | TYPE | FUNCTION |
|---|---|---|
| SINGLE | act | Acts as SINGLE key. |
| SLIPS CONTROLLED | var | Slip measurements. |
| SLIPS UNCONTROLLED | var | |
| SNAPSHOT | act | Snapshot report. |
| SPEAKER | par | Adjusts speaker vol. (1–9). |
| START TIME | par | View/edit test start time. |
| STATUS | act | Lists lit STATUS LEDs. |
| STOP | act | Stops testing. |
| STORE | act* | Store unit configuration (1–9). |
| STORED SETUP | act* | Prints stored setup (0–9). |
| TEST FOR | par | View/edit time value (var, during test). |
| THRESHOLD BPV SES | par | View/edit threshold (Sec 6.6.1). |
| THRESHOLD CRC6 SES | par | |
| THRESHOLD FRAME | par | |
| THRESHOLD HF JITTER | par | |
| THRESHOLD JITTER | par | |
| THRESHOLD PATTERN SES | par | |
| THRESHOLD WANDER | par | |
| TIE | var | Display TIE measurements. |
| TIME | par | View/edit time of day (Sec 4.4.4). |

**Table 8-2 Remote Control Commands** *(cont)*

| COMMAND | TYPE | FUNCTION |
|---|---|---|
| USER | par | Sets user pattern, (Sec 6.5). |
| WANDER HIT SECONDS | var | Wander measurements. |
| WANDER TYPE | par | View/edit wander type. (USER, G.824) |
| YELLOW EVENTS | var | Alarm measurements. |
| YELLOW SECONDS | var | |

## 8.3 INTERFACE PINOUTS AND CABLING

The following tables describe the pinouts for the 5108's LINE, RS-232C, and PARALLEL interface connectors.

**Table 8-3**
**LINE Interface Pinout**

| PIN | NAME | FUNCTION |
|---|---|---|
| 1 | R | 5108 Receive |
| 2 | T | 5108 Receive |
| 3 | reserved for future use | |
| 4 | R1 | 5108 Transmit |
| 5 | T1 | 5108 Transmit |
| 6 | reserved for future use | |
| 7 | Shield | Shields 5108 T1/R1 Xmit Pair |
| 8 | Shield | Shields 5108 T/R Receive Pair |

**Table 8-4**
**RS-232C Interface Pinout**

| PIN | NAME | FUNCTION |
|---|---|---|
| 1 | GND | Protective Ground |
| 2 | TXD | Transmitted Data Output |
| 3 | RXD | Received Data Input |
| 4 | RTS | Request to Send Output |
| 5 | CTS | Clear to Send Input |
| 6 | | Unused |
| 7 | GND | Signal Ground |
| 8 | DCD | Received Line Signal |
| | | Detect Input |
| 20 | DTR | Data Terminal Ready Output |
| All other pins | | No Connection |

**Table 8-5**
**Parallel Interface Pinout**

| PIN | NAME | PIN | NAME |
|---|---|---|---|
| 1 | Strobe | 10 | ACK |
| 2 | D0 | 11 | BUSY |
| 3 | D1 | 12 | PE |
| 4 | D2 | 13 | SLCT |
| 5 | D3 | 14 | AUTOFD |
| 6 | D4 | 15 | ERROR |
| 7 | D5 | 16 | INIT |
| 8 | D6 | 17 | SLCT IN |
| 9 | D7 | 18–25 | Ground |

### 8.3.1 RS-232 Cables

**Note:** When using the RS-232 port (Table 8-4), consider the 5108 to be a DCE-type device.

The proper type of cable to use with the 5108 depends on the application. When interfacing the 5108 with a "smart" terminal or printer, use a null-modem cable with pins 4 and 5 strapped at each end (Data Terminal Cable) as shown in Figure 8-2 on the next page.

When interfacing the 5108 with a "dumb" terminal or printer, use a straight-through cable (Data Set Cable) as shown in Figure 8-3 on the next page.

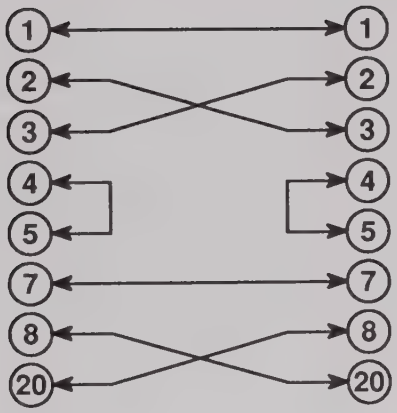



**Figure 8-2**
**"Smart" Null-modem Cable Wiring**
**(Data Terminal Cable)**

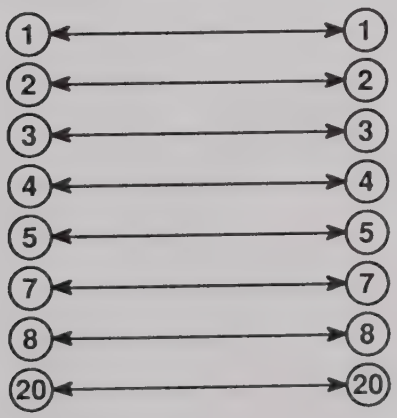



**Figure 8-3**
**"Dumb" Straight-through Cable Wiring**
**(Data Set Cable)**

## 8.4 BRIDGING PROBE

The 5108 Bridging Probe (PN: 9555-8422) is an accessory for the 5108 used to bridge T1/DS1 signals at central office points or customer Channel Service Unit (CSU) locations where normal DSX-1 monitor jacks are not available. The probe effectively isolates the T1 signal under test from the probe's own cord capacitance and the 5108 Test Set's input impedance. When used with a 5108, the effective impedance of the probe is 1K ohms (resistive) at T1 frequencies.

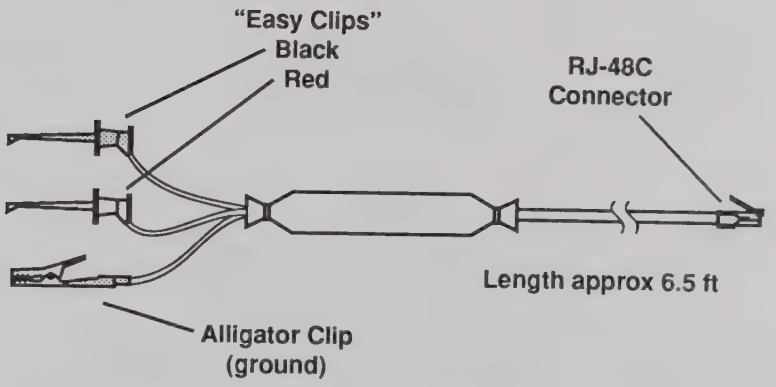



**Figure 8-4**
**5108 Bridge Probe**

### 8.4.1 Using the Bridging Probe

The probe connects to the LINE/PROBE jack on the front panel of the 5108. To use the bridging probe:

1. Connect the probe's RJ-48C (8-pin modular, see Fig 8-4) plug to the LINE/PROBE jack on the 5108's front panel.
2. Set the 5108 INTFC SELECT (interface select) control to PROBE. The LINE/PROBE jack's LED should light. See Sections 4.5.1 and 4.11.4.
3. Attach the probe's two "easy clips" (see Fig 8-4) to the points where the cable pair carrying the T1/DS1 signal will be accessed. The Red or Black clips may be connected to either side of the cable pair. The two clips must *not* be connected to the same side.
4. When possible, connect the probe's Ground (alligator clip, see Fig 8-4) to the T1 signal ground. This improves the 5108's immunity to noise. However use of the Ground clip is not mandatory for testing.

### 8.4.2 Probe Applications

**Note:** The 5108 Bridging Probe is not needed at DSX-1 bays equipped with normal monitor jacks (equipped with 430-ohm bridging resistors). At a normal DSX-1 bay, T1/DS1 signals can be bridged simply by plugging into a monitor jack (see Sec 4.11.2).

### 8.4.2.1 High-Frequency Distribution Frame

The 5108 Bridging Probe can be used to access either line-side or office-side T1 signals at a central office High-Frequency (T1) Distribution Frame. When using the probe, the 5108 automatically adjusts its internal gain and equalization to accommodate either type of signal. See Figure 8-5.

Note that signals coming from the T1 span line may be attenuated by 15 dB or more. Signals coming from the central office will be close to the nominal DSX-1 amplitude of 3.0 volts peak (0 dBdsx).

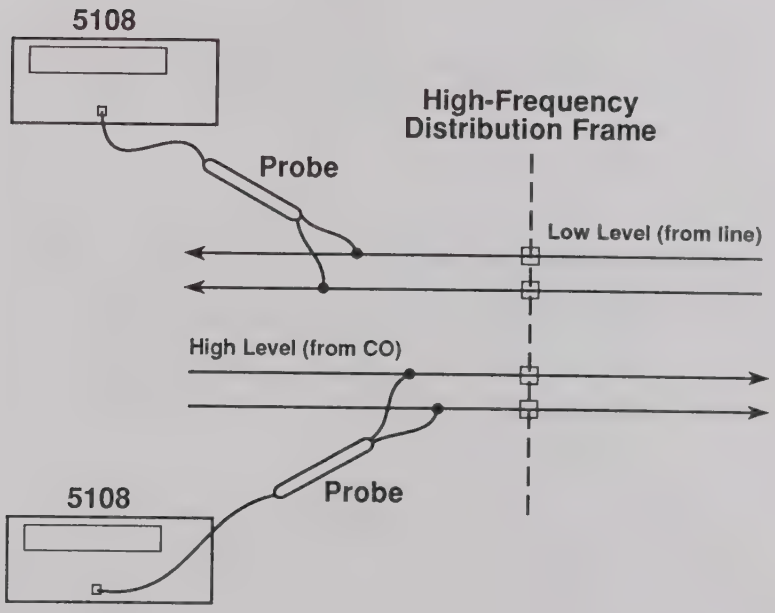



**Figure 8-5**
**Probe Used at HF Distribution Frame**

### 8.4.2.2 Customer CSU Location

The 5108 can be used to access T1 signals on the Line or Customer side of a T1 CSU. The 5108 automatically adjusts gain and equalization appropriately. See Figure 8-6.

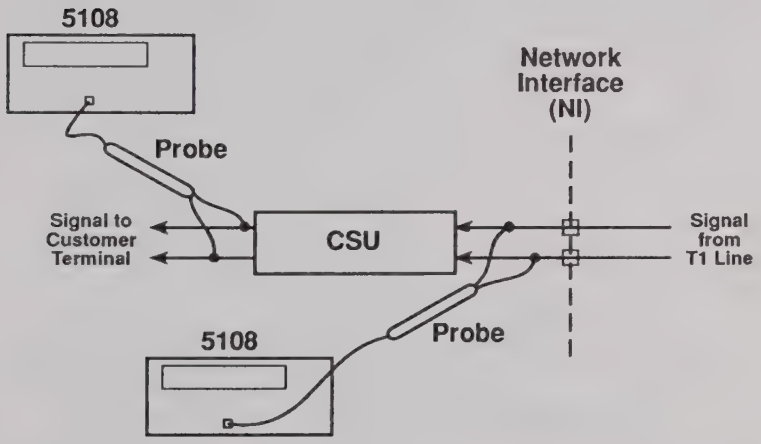



**Figure 8-6**
**Probe Used at CSU Location**

### 8.4.2.3 Other Locations Not Equipped with Monitor Jack Resistors

In General, the 5108 Bridging Probe may be used at central offices, customer locations, or any other point where the cable pair carrying a T1 signal can be physically accessed as long as the signal level at that point is within the probe's 0 to -22.5 dBdsx range. See Figure 8-7.

Note that the amplitude of some signals generated by channel banks and other DS1 terminals which are far from a DSX-1 bay or network interface point may be too "hot."

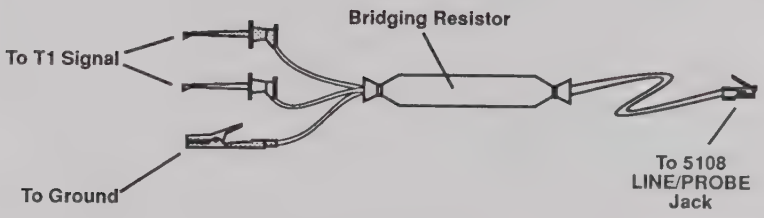



**Figure 8-7**
**General Bridge Probe Hook-up**

#### 8.4.2.4 Applications Not Supported: T1 Line Repeater Monitoring

The Automatic gain and equalization capabilities of the 5108 are compatible with T1 signals in carrier central offices and customer CSU locations. However, the 5108 cannot be used at a T1 apparatus case to monitor the low-level signals at T1 line repeater inputs. Signal levels at these points are normally too attenuated and fall outside the 5108's gain and equalization range.

### 8.4.3 Probe Specifications

| | |
|---|---|
| **Impedance** | 960 ohms resistive (when used with 5108) |
| **Connectors** | |
| **To T1 Signal:** | 2 Easy Clips |
| **To Ground:** | 1 Alligator Clip |
| **To 5108:** | 1 RJ-48C compatible plug |
| **T1 Signal Equalization Range** | 0 to -22.5 dBdsx (5108 used with Bridging Probe) |
| **Overall Length** | Approximately 6.5 feet (200 centimeters) |

## 8.5 VOLTS PEAK TO dBdsx CONVERSION

The 5108 displays the DSX jack's signal measurement, DSX AMP, in volts peak (see Sec 5.7). Table 8-6 converts the 5108's volt measurement into decibels from a nominal DSX signal (dBdsx). The dB measurements are referenced at 3 volts—a reading of 3.00 volts peak on the 5108 is equivalent to 0.00 dBdsx.

The formula to convert volts peak to dBdsx is shown below:

$$\mathbf{dBdsx = 20 \log \frac{V_1}{V_2}}$$

where $\mathbf{V_1}$ is the reference level of 3 volts, and $\mathbf{V_2}$ is the actual DSX AMP measurement.

To use Table 8-6, press the CATEGORY and MEASUREMENT keys to show the SIGNAL DSX AMP measurement on the 5108 display. Next find the value shown on the 5108 listed in the **V-pk** column of Table 8-6. The corresponding **dBdsx** value is listed in the column to the right.

For example: if the 5108 shows a DSX AMP reading of 2.79 volts pk, the dBdsx equivalent is -0.63 as shown in Table 8-6 on page 125.

**Note:** There is also an abbreviated version of Table 8-6 shipped with each unit. This table is an adhesive label which may be mounted on the upper surface of the front-panel bezel for convenient reference.

## Table 8-6
## Volts Peak to dBdsx Conversion

| V-pk | dBdsx | V-pk | dBdsx | V-pk | dBbsx | V-pk | dBdsx |
|---|---|---|---|---|---|---|---|
| **6.00** | **6.02** | 5.69 | 5.56 | 5.38 | 5.07 | 5.07 | 4.56 |
| 5.99 | 6.01 | 5.68 | 5.54 | 5.37 | 5.06 | 5.06 | 4.54 |
| 5.98 | 5.99 | 5.67 | 5.53 | 5.36 | 5.04 | 5.05 | 4.52 |
| 5.97 | 5.98 | 5.66 | 5.51 | 5.35 | 5.02 | 5.04 | 4.51 |
| 5.96 | 5.96 | 5.65 | 5.50 | 5.34 | 5.01 | 5.03 | 4.49 |
| 5.95 | 5.95 | 5.64 | 5.48 | 5.33 | 4.99 | 5.02 | 4.47 |
| 5.94 | 5.93 | 5.63 | 5.47 | 5.32 | 4.98 | 5.01 | 4.45 |
| 5.93 | 5.92 | 5.62 | 5.45 | 5.31 | 4.96 | **5.00** | **4.44** |
| 5.92 | 5.90 | 5.61 | 5.44 | 5.30 | 4.94 | 4.99 | 4.42 |
| 5.91 | 5.89 | 5.60 | 5.42 | 5.29 | 4.93 | 4.98 | 4.40 |
| 5.90 | 5.87 | 5.59 | 5.41 | 5.28 | 4.91 | 4.97 | 4.38 |
| 5.89 | 5.86 | 5.58 | 5.39 | 5.27 | 4.89 | 4.96 | 4.37 |
| 5.88 | 5.85 | 5.57 | 5.37 | 5.26 | 4.88 | 4.95 | 4.35 |
| 5.87 | 5.83 | 5.56 | 5.36 | 5.25 | 4.86 | 4.94 | 4.33 |
| 5.86 | 5.82 | 5.55 | 5.34 | 5.24 | 4.84 | 4.93 | 4.31 |
| 5.85 | 5.80 | 5.54 | 5.33 | 5.23 | 4.83 | 4.92 | 4.30 |
| 5.84 | 5.79 | 5.53 | 5.31 | 5.22 | 4.81 | 4.91 | 4.28 |
| 5.83 | 5.77 | 5.52 | 5.30 | 5.21 | 4.79 | 4.90 | 4.26 |
| 5.82 | 5.76 | 5.51 | 5.28 | 5.20 | 4.78 | 4.89 | 4.24 |
| 5.81 | 5.74 | **5.50** | **5.26** | 5.19 | 4.76 | 4.88 | 4.23 |
| 5.80 | 5.73 | 5.49 | 5.25 | 5.18 | 4.74 | 4.87 | 4.21 |
| 5.79 | 5.71 | 5.48 | 5.23 | 5.17 | 4.73 | 4.86 | 4.19 |
| 5.78 | 5.70 | 5.47 | 5.22 | 5.16 | 4.71 | 4.85 | 4.17 |
| 5.77 | 5.68 | 5.46 | 5.20 | 5.15 | 4.69 | 4.84 | 4.15 |
| 5.76 | 5.67 | 5.45 | 5.19 | 5.14 | 4.68 | 4.83 | 4.14 |
| 5.75 | 5.65 | 5.44 | 5.17 | 5.13 | 4.66 | 4.82 | 4.12 |
| 5.74 | 5.64 | 5.43 | 5.15 | 5.12 | 4.64 | 4.81 | 4.10 |
| 5.73 | 5.62 | 5.42 | 5.14 | 5.11 | 4.63 | 4.80 | 4.08 |
| 5.72 | 5.61 | 5.41 | 5.12 | 5.10 | 4.61 | 4.79 | 4.06 |
| 5.71 | 5.59 | 5.40 | 5.11 | 5.09 | 4.59 | 4.78 | 4.05 |
| 5.70 | 5.58 | 5.39 | 5.09 | 5.08 | 4.57 | 4.77 | 4.03 |

**Table 8-6** *(cont)*
**Volts Peak to dBdsx Conversion**

| V-pk | dBdsx | V-pk | dBdsx | V-pk | dBdsx | V-pk | dBdsx |
|---|---|---|---|---|---|---|---|
| 4.76 | 4.01 | 4.45 | 3.42 | 4.14 | 2.80 | 3.83 | 2.12 |
| 4.75 | 3.99 | 4.44 | 3.41 | 4.13 | 2.78 | 3.82 | 2.10 |
| 4.74 | 3.97 | 4.43 | 3.39 | 4.12 | 2.76 | 3.81 | 2.08 |
| 4.73 | 3.95 | 4.42 | 3.37 | 4.11 | 2.73 | 3.80 | 2.05 |
| 4.72 | 3.94 | 4.41 | 3.35 | 4.10 | 2.71 | 3.79 | 2.03 |
| 4.71 | 3.92 | 4.40 | 3.33 | 4.09 | 2.69 | 3.78 | 2.01 |
| 4.70 | 3.90 | 4.39 | 3.31 | 4.08 | 2.67 | 3.77 | 1.98 |
| 4.69 | 3.88 | 4.38 | 3.29 | 4.07 | 2.65 | 3.76 | 1.96 |
| 4.68 | 3.86 | 4.37 | 3.27 | 4.06 | 2.63 | 3.75 | 1.94 |
| 4.67 | 3.84 | 4.36 | 3.25 | 4.05 | 2.61 | 3.74 | 1.92 |
| 4.66 | 3.83 | 4.35 | 3.23 | 4.04 | 2.59 | 3.73 | 1.89 |
| 4.65 | 3.81 | 4.34 | 3.21 | 4.03 | 2.56 | 3.72 | 1.87 |
| 4.64 | 3.79 | 4.33 | 3.19 | 4.02 | 2.54 | 3.71 | 1.85 |
| 4.63 | 3.77 | 4.32 | 3.17 | 4.01 | 2.52 | 3.70 | 1.82 |
| 4.62 | 3.75 | 4.31 | 3.15 | **4.00** | **2.50** | 3.69 | 1.80 |
| 4.61 | 3.73 | 4.30 | 3.13 | 3.99 | 2.48 | 3.68 | 1.77 |
| 4.60 | 3.71 | 4.29 | 3.11 | 3.98 | 2.46 | 3.67 | 1.75 |
| 4.59 | 3.69 | 4.28 | 3.09 | 3.97 | 2.43 | 3.66 | 1.73 |
| 4.58 | 3.67 | 4.27 | 3.07 | 3.96 | 2.41 | 3.65 | 1.70 |
| 4.57 | 3.66 | 4.26 | 3.05 | 3.95 | 2.39 | 3.64 | 1.68 |
| 4.56 | 3.64 | 4.25 | 3.03 | 3.94 | 2.37 | 3.63 | 1.66 |
| 4.55 | 3.62 | 4.24 | 3.00 | 3.93 | 2.35 | 3.62 | 1.63 |
| 4.54 | 3.60 | 4.23 | 2.98 | 3.92 | 2.32 | 3.61 | 1.61 |
| 4.53 | 3.58 | 4.22 | 2.96 | 3.91 | 2.30 | 3.60 | 1.58 |
| 4.52 | 3.56 | 4.21 | 2.94 | 3.90 | 2.28 | 3.59 | 1.56 |
| 4.51 | 3.54 | 4.20 | 2.92 | 3.89 | 2.26 | 3.58 | 1.54 |
| **4.50** | **3.52** | 4.19 | 2.90 | 3.88 | 2.23 | 3.57 | 1.51 |
| 4.49 | 3.50 | 4.18 | 2.88 | 3.87 | 2.21 | 3.56 | 1.49 |
| 4.48 | 3.48 | 4.17 | 2.86 | 3.86 | 2.19 | 3.55 | 1.46 |
| 4.47 | 3.46 | 4.16 | 2.84 | 3.85 | 2.17 | 3.54 | 1.44 |
| 4.46 | 3.44 | 4.15 | 2.82 | 3.84 | 2.14 | 3.53 | 1.41 |

**Table 8-6** *(cont)*
**Volts Peak to dBdsx Conversion**

| V-pk | dBdsx | V-pk | dBdsx | V-pk | dBdsx | V-pk | dBdsx |
|---|---|---|---|---|---|---|---|
| 3.52 | 1.39 | 3.21 | 0.59 | 2.90 | -0.29 | 2.59 | -1.28 |
| 3.51 | 1.36 | 3.20 | 0.56 | 2.89 | -0.32 | 2.58 | -1.31 |
| **3.50** | **1.34** | 3.19 | 0.53 | 2.88 | -0.35 | 2.57 | -1.34 |
| 3.49 | 1.31 | 3.18 | 0.51 | 2.87 | -0.38 | 2.56 | -1.38 |
| 3.48 | 1.29 | 3.17 | 0.48 | 2.86 | -0.42 | 2.55 | -1.41 |
| 3.47 | 1.26 | 3.16 | 0.45 | 2.85 | -0.45 | 2.54 | -1.45 |
| 3.46 | 1.24 | 3.15 | 0.42 | 2.84 | -0.48 | 2.53 | -1.48 |
| 3.45 | 1.21 | 3.14 | 0.40 | 2.83 | -0.51 | 2.52 | -1.51 |
| 3.44 | 1.19 | 3.13 | 0.37 | 2.82 | -0.54 | 2.51 | -1.55 |
| 3.43 | 1.16 | 3.12 | 0.34 | 2.81 | -0.57 | **2.50** | **-1.58** |
| 3.42 | 1.14 | 3.11 | 0.31 | 2.80 | -0.60 | 2.49 | -1.62 |
| 3.41 | 1.11 | 3.10 | 0.28 | 2.79 | -0.63 | 2.48 | -1.65 |
| 3.40 | 1.09 | 3.09 | 0.26 | 2.78 | -0.66 | 2.47 | -1.69 |
| 3.39 | 1.06 | 3.08 | 0.23 | 2.77 | -0.69 | 2.46 | -1.72 |
| 3.38 | 1.04 | 3.07 | 0.20 | 2.76 | -0.72 | 2.45 | -1.76 |
| 3.37 | 1.01 | 3.06 | 0.17 | 2.75 | -0.76 | 2.44 | -1.79 |
| 3.36 | 0.98 | 3.05 | 0.14 | 2.74 | -0.79 | 2.43 | -1.83 |
| 3.35 | 0.96 | 3.04 | 0.12 | 2.73 | -0.82 | 2.42 | -1.87 |
| 3.34 | 0.93 | 3.03 | 0.09 | 2.72 | -0.85 | 2.41 | -1.90 |
| 3.33 | 0.91 | 3.02 | 0.06 | 2.71 | -0.88 | 2.40 | -1.94 |
| 3.32 | 0.88 | 3.01 | 0.03 | 2.70 | -0.92 | 2.39 | -1.97 |
| 3.31 | 0.85 | **3.00** | **0.00** | 2.69 | -0.95 | 2.38 | -2.01 |
| 3.30 | 0.83 | 2.99 | -0.03 | 2.68 | -0.98 | 2.37 | -2.05 |
| 3.29 | 0.80 | 2.98 | -0.06 | 2.67 | -1.01 | 2.36 | -2.08 |
| 3.28 | 0.78 | 2.97 | -0.09 | 2.66 | -1.04 | 2.35 | -2.12 |
| 3.27 | 0.75 | 2.96 | -0.12 | 2.65 | -1.08 | 2.34 | -2.16 |
| 3.26 | 0.72 | 2.95 | -0.15 | 2.64 | -1.11 | 2.33 | -2.20 |
| 3.25 | 0.70 | 2.94 | -0.18 | 2.63 | -1.14 | 2.32 | -2.23 |
| 3.24 | 0.67 | 2.93 | -0.21 | 2.62 | -1.18 | 2.31 | -2.27 |
| 3.23 | 0.64 | 2.92 | -0.23 | 2.61 | -1.21 | 2.30 | -2.31 |
| 3.22 | 0.61 | 2.91 | -0.26 | 2.60 | -1.24 | 2.29 | -2.35 |

**Table 8-6** *(cont)*
**Volts Peak to dBdsx Conversion**

| V-pk | dBdsx | V-pk | dBdsx | V-pk | dBdsx | V-pk | dBdsx |
|---|---|---|---|---|---|---|---|
| 2.28 | -2.38 | 1.97 | -3.65 | 1.66 | -5.14 | 1.35 | -6.94 |
| 2.27 | -2.42 | 1.96 | -3.70 | 1.65 | -5.19 | 1.34 | -7.00 |
| 2.26 | -2.46 | 1.95 | -3.74 | 1.64 | -5.25 | 1.33 | -7.07 |
| 2.25 | -2.50 | 1.94 | -3.79 | 1.63 | -5.30 | 1.32 | -7.13 |
| 2.24 | -2.54 | 1.93 | -3.83 | 1.62 | -5.35 | 1.31 | -7.20 |
| 2.23 | -2.58 | 1.92 | -3.88 | 1.61 | -5.41 | 1.30 | -7.26 |
| 2.22 | -2.62 | 1.91 | -3.92 | 1.60 | -5.46 | 1.29 | -7.33 |
| 2.21 | -2.65 | 1.90 | -3.97 | 1.59 | -5.51 | 1.28 | -7.40 |
| 2.20 | -2.69 | 1.89 | -4.01 | 1.58 | -5.57 | 1.27 | -7.47 |
| 2.19 | -2.73 | 1.88 | -4.06 | 1.57 | -5.62 | 1.26 | -7.54 |
| 2.18 | -2.77 | 1.87 | -4.11 | 1.56 | -5.68 | 1.25 | -7.60 |
| 2.17 | -2.81 | 1.86 | -4.15 | 1.55 | -5.74 | 1.24 | -7.67 |
| 2.16 | -2.85 | 1.85 | -4.20 | 1.54 | -5.79 | 1.23 | -7.74 |
| 2.15 | -2.89 | 1.84 | -4.25 | 1.53 | -5.85 | 1.22 | -7.82 |
| 2.14 | -2.93 | 1.83 | -4.29 | 1.52 | -5.91 | 1.21 | -7.89 |
| 2.13 | -2.97 | 1.82 | -4.34 | 1.51 | -5.96 | 1.20 | -7.96 |
| 2.12 | -3.02 | 1.81 | -4.39 | **1.50** | **-6.02** | 1.19 | -8.03 |
| 2.11 | -3.06 | 1.80 | -4.44 | 1.49 | -6.08 | 1.18 | -8.10 |
| 2.10 | -3.10 | 1.79 | -4.49 | 1.48 | -6.14 | 1.17 | -8.18 |
| 2.09 | -3.14 | 1.78 | -4.53 | 1.47 | -6.20 | 1.16 | -8.25 |
| 2.08 | -3.18 | 1.77 | -4.58 | 1.46 | -6.26 | 1.15 | -8.33 |
| 2.07 | -3.22 | 1.76 | -4.63 | 1.45 | -6.32 | 1.14 | -8.40 |
| 2.06 | -3.27 | 1.75 | -4.68 | 1.44 | -6.38 | 1.13 | -8.48 |
| 2.05 | -3.31 | 1.74 | -4.73 | 1.43 | -6.44 | 1.12 | -8.56 |
| 2.04 | -3.35 | 1.73 | -4.78 | 1.42 | -6.50 | 1.11 | -8.64 |
| 2.03 | -3.39 | 1.72 | -4.83 | 1.41 | -6.56 | 1.10 | -8.71 |
| 2.02 | -3.44 | 1.71 | -4.88 | 1.40 | -6.62 | 1.09 | -8.79 |
| 2.01 | -3.48 | 1.70 | -4.93 | 1.39 | -6.68 | 1.08 | -8.87 |
| **2.00** | **-3.52** | 1.69 | -4.98 | 1.38 | -6.74 | 1.07 | -8.95 |
| 1.99 | -3.57 | 1.68 | -5.04 | 1.37 | -6.81 | 1.06 | -9.04 |
| 1.98 | -3.61 | 1.67 | -5.09 | 1.36 | -6.87 | 1.05 | -9.12 |

**Table 8-6** *(cont)*
**Volts Peak to dBdsx Conversion**

| V-pk | dBdsx | V-pk | dBdsx | V-pk | dBdsx | V-pk | dBdsx |
|---|---|---|---|---|---|---|---|
| 1.04 | -9.20 | 0.81 | -11.37 | 0.58 | -14.27 | 0.35 | -18.66 |
| 1.03 | -9.29 | 0.80 | -11.48 | 0.57 | -14.42 | 0.34 | -18.91 |
| 1.02 | -9.37 | 0.79 | -11.59 | 0.56 | -14.58 | 0.33 | -19.17 |
| 1.01 | -9.46 | 0.78 | -11.70 | 0.55 | -14.74 | 0.32 | -19.44 |
| **1.00** | **-9.54** | 0.77 | -11.81 | 0.54 | -14.89 | 0.31 | -19.72 |
| 0.99 | -9.63 | 0.76 | -11.93 | 0.53 | -15.06 | 0.30 | -20.00 |
| 0.98 | -9.72 | 0.75 | -12.04 | 0.52 | -15.22 | 0.29 | -20.29 |
| 0.97 | -9.81 | 0.74 | -12.16 | 0.51 | -15.39 | 0.28 | -20.60 |
| 0.96 | -9.90 | 0.73 | -12.28 | **0.50** | **-15.56** | 0.27 | -20.92 |
| 0.95 | -9.99 | 0.72 | -12.40 | 0.49 | -15.74 | 0.26 | -21.24 |
| 0.94 | -10.08 | 0.71 | -12.52 | 0.48 | -15.92 | 0.25 | -21.58 |
| 0.93 | -10.17 | 0.70 | -12.64 | 0.47 | -16.10 | 0.24 | -21.94 |
| 0.92 | -10.27 | 0.69 | -12.77 | 0.46 | -16.29 | 0.23 | -22.31 |
| 0.91 | -10.36 | 0.68 | -12.89 | 0.45 | -16.48 | 0.22 | -22.69 |
| 0.90 | -10.46 | 0.67 | -13.02 | 0.44 | -16.67 | 0.21 | -23.10 |
| 0.89 | -10.55 | 0.66 | -13.15 | 0.43 | -16.87 | 0.20 | -23.52 |
| 0.88 | -10.65 | 0.65 | -13.28 | 0.42 | -17.08 | 0.19 | -23.97 |
| 0.87 | -10.75 | 0.64 | -13.42 | 0.41 | -17.29 | 0.18 | -24.44 |
| 0.86 | -10.85 | 0.63 | -13.56 | 0.40 | -17.50 | 0.17 | -24.93 |
| 0.85 | -10.95 | 0.62 | -13.69 | 0.39 | -17.72 | 0.16 | -25.46 |
| 0.84 | -11.06 | 0.61 | -13.84 | 0.38 | -17.95 | **0.15** | **-26.02** |
| 0.83 | -11.16 | 0.60 | -13.98 | 0.37 | -18.18 | | |
| 0.82 | -11.27 | 0.59 | -14.13 | 0.36 | -18.42 | | |

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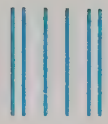

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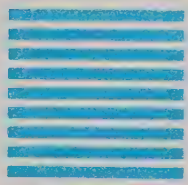

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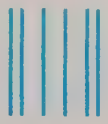
**Tau-tron Inc.**
Publications Manager
10 Lyberty Way
Westford, MA 01886-9978



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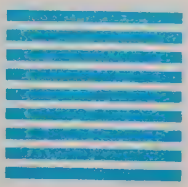

POSTAGE WILL BE PAID BY ADDRESSEE:

**Tau-tron Inc.**
Sales Department
10 Lyberty Way
Westford, MA 01886-9978

# Repair Returns

## To return a unit for repair

1. Call the Customer Service Dept. **(508) 692-5100** or **1-800-TAU-TRON (outside MA),** for a **Repair Authorization Number.** This will reduce administrative delays and ensure prompt return of your unit.
2. Complete and **attach the Repair Tag** below to your unit.
3. **Pack the unit** in the original shipping carton and packaging materials, if available. Otherwise use a double-walled carton (test strength of 350 lb) and shock absorbing material such as bubble wrap to prevent the unit from moving in the carton during transit. Seal with heavy paper tape.
4. **Send to:** Tau-tron Inc.
   10 Lyberty Way
   Westford, MA 01886
   Attn: Customer Service

## Repair Tag

Repair Authorization Number _____

Model _____ Serial Number _____

☐ Warranty ☐ Dead on arrival ☐ Repair ☐ Modification ☐ Recalibration

Symptoms: _____

_____

Name _____ Title _____

Company _____ Dept./MS _____

Address _____ City _____

State & Zip _____ Phone _____

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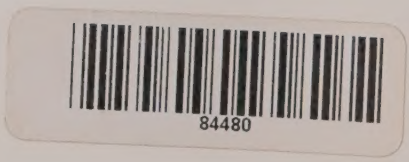


Tau-tron Inc., 10 Lyberty Way, Westford, MA 01886 (508) 692-5100
Telex 750245 (1-800-TAU-TRON (1-800-828-8766), outside MA) FAX 508-692-1938